Appendix E–2

Revised Phase I Construction Specifications (SPC-458)

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CONSTRUCTION SPECIFICATION

PROJECT FILE NO. 020978

OU 3-13 Group ▮ Tank Farm Interim Action Phase ▮

Approved for Construction

Prepared for:
U.S. Department of Energy
Idaho Operations Office
Idaho Falls, Idaho

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07/24/2001
Rev. 03

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SIGNATURES

6. Type or Printed Name / Signature	7. Signature Code	7. Date	8. Organization/ Discipline
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9. Document Control Release Signature: 6B43 Date: 5/14/03

RECORDSMANAGEMENT

10. Is this a Construction Specification? Yes ☒ No ☐ 11. NCR Related? Yes ☐ No ☒

12. Does document contain sensitive, unclassified information? ☐ Yes ☐ No If Yes, what category:

13. Can document be externally distributed? Yes ☒ No ☐

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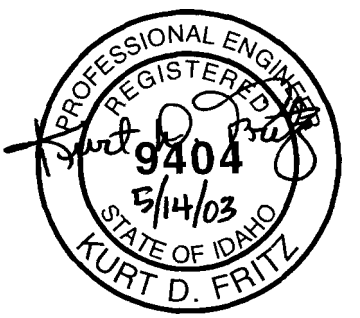
Item or activity **to** which the **QA** Records **apply:**

18. Periodic Review Frequency: N/A ☒, 5 years ☐, or Other

OU 3-13 Group 1 Tank Farm Interim Action Phase 1
Revision 1

The following Sections of this Specification were prepared under the direction of the Professional Engineers as indicated by the seal and signature provided on this page. The Professional Engineers are registered in the State of Idaho to practice Civil/Structural Engineering.



Division 1 -- General Requirements

01005 -- Summary of Work
01051 -- Construction Surveying and Staking
01300 -- Submittals

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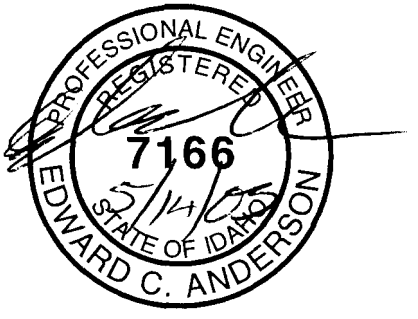
OU 3-13 Group 1 Tank Farm Interim Action Phase 1
Revision 1

The following Sections of this Specification were prepared under the direction of the Professional Engineers as indicated by the seal and signature provided on this page. The Professional Engineers are registered in the State of Idaho to practice Mechanical Engineering.



Division 15 -- Mechanical

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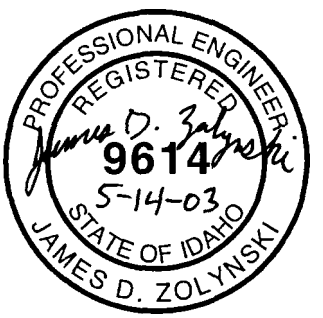
OU 3-13 Group 1 Tank Farm Interim Action Phase 1
Revision 1

The following Sections of this Specification were prepared under the direction of the Professional Engineer as indicated by the seal and signature provided on this page. The Professional Engineer is registered in the State of Idaho to practice Electrical Engineering.



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16120 -- Cable, Wire, Connectors and Miscellaneous Devices
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SPECIFICATIONS
FOR
OU 3-13, Group 1, Tank Farm Interim Action Phase 1
Revision 1

Prepared for:

U. S. DEPARTMENT OF ENERGY
IDAHO OPERATIONS OFFICE

Idaho Falls, Idaho

Project File No. 020978

~~April~~ **May 2003**

BECHTEL BWXT IDAHO, LLC (BBWI)
Idaho Falls, Idaho 83415

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SECTION 01005--SUMMARY OF WORK

PART 1--GENERAL

SUMMARY:

The Subcontractor shall furnish plant, labor, material, equipment, supplies and perform work and operations necessary to construct the upgrades to the INTEC Storm Drainage System, in accordance with the subcontract drawings and these specifications.

This project was originally subcontracted in the year 2000 and work continued through 2001. Due to funding limitations, the subcontract was terminated and the project was not completed. The scope of this project includes completing the portion of the original scope of work identified as Phase 1 as shown on the contract drawings.

Section Includes: Work includes, but is not limited to:

Re-grading areas to improve drainage and installing plant mix paving

Upgrading of the Storm Drainage System including: new concrete ditches, installing or replacing corrugated metal pipe culverts and concrete head walls and end walls

Minor grading and completion of a lined evaporation pond, leak detection system and associated electrical work.

Modification of duct bank and installation/splicing of 15kV cable.

REFERENCES:

The following documents, including others referenced therein, form part of this Section to the extent designated herein.

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1910	OSHA General Industry Safety Standards
29 CFR 1926	OSHA Construction Industry Safety Standards

BECHTEL BWXT IDAHO, LLC (BBWI)

Subcontractor Requirements Manual

Health and Safety Plan for Waste Area Group 3, Operable Unit 3-13, Group 1 Soils, Tank Farm Interim Action, INEEL/EXT-2000-00194

Emergency Preparedness Plan - Addendum 2 (ICPP [INTEC]), Latest Revision, Company Wide Manual 16A-2, PLN-114-2

Unless otherwise specified, references in these specifications or on the subcontract drawings to other specifications, codes, standards or manuals which are part of these specifications, but not included herein, shall be the latest edition, including any amendments and revisions, in effect as of the date of this Specification.

SUBMITTALS:

See Section 01300, Submittals.

OUALITY ASSURANCE:

Quality Assurance Program requirements shall exist to assure that work performed is in conformance with the requirements established by the drawings and this specification. QA Program criteria applicable to this scope of work is addressed in the Special Conditions and these specifications.

Standard Products: The materials and equipment furnished by the Subcontractor shall be standard products of manufacturers regularly engaged in the production of the type of materials and equipment required and shall be of the manufacturer's latest standard designs. Where two or more units of the same type and class of material or equipment are required, the units shall be the product of the same manufacturer, and shall be identical insofar as possible. The component parts of a unit of equipment need not be the products of the manufacturer.

SAFETY. HEALTH AND ENVIRONMENT:

All work shall be conducted in compliance with the Health and Safety Plan for Waste Area Group 3, Operable Unit 3-13, Group 1 Soils, Tank Farm Interim Action, INEEL/EXT-2000-00194.

In general work shall be in compliance with the applicable sections of 29 CFR 1910, 29 CFR 1926 and the BBWI Subcontractor Requirements Manual.

DELIVERY STORAGE AND HANDLING:

All materials normally packaged shall be delivered to the site in the original, unopened packages with labels intact. Upon arrival, the Subcontractor shall inspect the materials or equipment for damage.

Materials and equipment shall be stored and handled in accordance with the manufacturer's instructions.

All hazardous materials shall be stored in such a manner to prevent spillage. Preventative spill measures shall be required and implemented per the manufacturer's specifications. Preventative spill measures and spill response activities shall be conducted in accordance with the project Health and Safety Plan and the INEEL Emergency Preparedness Plan - Addendum 2 (ICPP [INTEC]), latest revision.

PART 2--PRODUCTS

MATERIALS:

New Materials and Equipment: Materials and equipment received by the Subcontractor in a damaged condition shall be repaired or replaced by the Subcontractor as directed by the Contractor. Materials and equipment damaged by the Subcontractor shall be repaired or replaced by the Subcontractor.

Approved Equal: Whenever a product is specified by using a proprietary name, the name of a manufacturer, or vendor, the specific item mentioned shall be understood as establishing type, function, dimension, and quality desired. Other manufacturer's products will be accepted, provided sufficient information is submitted to determine that products proposed are equivalent to those named. The interface and coordination of the approved equal product is the responsibility of the Subcontractor.

Existing Materials, Equipment and Structures: Existing materials, equipment and structures, including paint and protective coatings, involved under this subcontract shall be thoroughly inspected by the Subcontractor before starting any work. Any defects or damages, the repair of which are not covered under these specifications or subcontract drawings, shall be reported in writing to the Contractor by the Subcontractor. The Subcontractor shall place reinstalled operating equipment in an operating condition that is at least as good as it was at the time the Subcontractor started work.

Hazardous Chemicals and Substances: The Subcontractor shall comply with applicable requirements of 29 CFR 1926.59, Hazard Communication Standard.

PART 3--CONSTRUCTION AND INSTALLATION

General: Materials and equipment shall be erected or installed only by qualified personnel who are regularly engaged in the trades required to complete the work. The subcontract drawings show the general arrangement and space allocation of the equipment specified. It shall be the Subcontractor's responsibility to verify changes in conditions or rearrangements necessary because of substitutions for specified materials or equipment. Where rearrangements are necessary the Subcontractor shall, before construction or installation, prepare and submit drawings of the proposed rearrangement for approval.

Coordination of Work: Where new work and existing facilities are shown on the drawings, but are not located precisely by dimensions, the Subcontractor shall be responsible for proper location and clearances and for correcting discrepancies and interferences in the work which are a result of his operations. Work done by one trade that must be integrated with work of other trades shall be laid out with due regard to the work done, or to be done, by other trades; particularly if the work done by one trade depends upon completion or proper installation of work done by other trades. The Subcontractor shall cooperate in coordinating his work with work being done by others if their work must be integrated with the Subcontractor's work. The Subcontractor shall notify the Contractor at least one week prior to starting of the date on which the Subcontractor proposes to proceed with the work.

Workmanship: Work shall be done in a skillful and workmanlike manner. The Subcontractor shall do structural cutting, fitting, patching, repairing and associated work necessary for installation of equipment, piping and electrical conduits, etc. No major cuts or holes, not shown on the drawings, shall be made without prior approval of the Contractor. After the equipment and/or piping is installed, exposed holes, cracks and other defects shall be neatly patched and the patched areas shall match the adjoining materials and finish.

END OF SECTION 01005

SECTION 01051--CONSTRUCTION SURVEYING AND STAKING

PART 1--GENERAL

SUMMARY:

Section Includes: Work includes, but is not limited to:

Establish vertical and horizontal control

The Subcontractor shall furnish all materials, labor, tools and equipment to perform all surveying necessary to layout and control the construction work. The Subcontractor shall perform surveying to establish horizontal and vertical control, set grade-stakes for ditch alignments, asphalt paving, pipe layout and alignments, and provide as-built surveys. All underground pipelines or structures uncovered during the excavation shall also be located by survey. The Subcontractor may perform the surveying, or an independent survey firm, provided the work is performed under the supervision of a Registered Land Surveyor in the State of Idaho.

All coordinates are based on INTEC site-specific horizontal coordinates and NRTS vertical datum. NRTS vertical is 0.35 ft. higher than INTEC vertical datum.

SUBMITTALS:

Submittals include but are not limited to the following:

Certification: Submit certification that the land surveyor is a registered professional.

As-built Survey Data: During the progress of the work, submit as-built survey data as each concrete ditch alignment, paved area, or final grading of the pond is completed. The survey data shall be transmitted to the Contractor in hard copy and electronic format. All final submittals of survey data shall be bound and shall include the title and description of the survey data, a table of contents or index, complete list with point number, coordinates, elevation, component description and date. The limits of the as-built survey for each area shall include, **as** a minimum, the following information. For ditches installed, the top edges of concrete, the bottom edges or centerline, culvert inverts, and top edge of the graded shoulders. Cross-sections shall be taken every 25 lineal feet of ditch and at all angle points. For paved areas, topographic shots shall be taken at edges of pavement, comers and swales. As-built survey for final grading of the evaporation pond shall take place prior to lining. The topographic survey shall define the final pond surface and all grade breaks.

See Section 01300, Submittals and Vendor Data Schedule for additional requirements.

QUALITY CONTROL:

Qualifications: Construction surveying and staking shall be accomplished under the direction of a registered professional land surveyor.

PART 2--PRODUCTS

Stakes: Identification stakes and hubs shall be of sufficient length, width and depth to provide a solid set in the ground and to provide space for marking above ground when applicable. The top 2-in. of all slope, guard, reference, clearing, and structure stakes shall be painted or marked with plastic flagging.

PART 3--EXECUTION

SURVEY REQUIREMENT:

Precision: Precision **and** accuracy requirements are contained in Table 1. The following precisions shall be used:

Slope Staking - Precision B
Ditch Grade Staking, - Precision **A**

Control: Existing control monuments can be located through the INEEL Construction Management *(5*26-3597).

Slope Stakes, Clearing; Limits and Reference Stakes: Slope catch-points, clearing limits, and slope reference stakes shall be established. The position of these stakes shall be determined by methods that will produce on the ground the precisions shown in the Table 1.

Clearing limits shall be set within the tolerance shown in the Table 1. The clearing limit shall be located on the ground and marked with lath, flagging, or other methods approved by the Contractor's Representative.

The elevation and location of slope reference stakes shall be verified for accuracy by a differential level run over the reference stakes between benchmarks.

Monuments of Property Boundaries or Surveys of Other Agencies: If property boundary or survey monuments, or survey markers of other agencies, are found within or adjacent to the construction limits, the Subcontractor shall immediately notify the Contractor's Representative. These monuments shall not be disturbed.

Grade Stakes: Grade stakes are required on the subbase for the concrete ditches. Stakes shall be set every 25-ft and at angle points or curves. Stakes shall be set when subbase is within 0.1 ft of final grade. The stakes shall be set to the nearest 0.01 ft of the measured grade line.

TABLE 1. CROSS SECTION **AND** SLOPE-STAKE PRECISION

Item	Precision A	B	C
Cross section topography measurements shall be taken so that variations in ground from a straight line connecting the cross section points will not exceed:	*0.5* ft	1.0 ft	2.0 ft
Horizontal and vertical accuracy for cross-sections. In feet or percentage of horizontal distance measured from transverse line, whichever is greater.	.05 ft or 0.2%	0.15 ft or 0.6%	0.2 ft or 1.0%
Horizontal and vertical accuracy for slope stake, slope stake references, and clearing limits. In feet or percentage of horizontal distance measured from centerline or reference stake, whichever is greater.			
a. Slope reference stakes and slope stakes.	0.1 ft or 0.4%	0.15 ft or 0.6%	0.2 ft or 1.0%
b. Clearing limits.	1.0 ft	1.0 ft	1.0 ft

FIELD QUALITY CONTROL:

Surveillance will be performed by the Contractor's Representative to verify compliance of the work to the drawings and specifications.

END OF SECTION 01051

SECTION 01300--SUBMITTALS

PART 1--GENERAL

SUMMARY:

This section specifies the administrative, technical and quality requirements for vendor data submittals. Vendor data requirements are identified in individual specification sections and tabularized on a Vendor Data Schedule. In the event of conflicting requirements, the submittal requirements prescribed in the individual specification section shall prevail.

The Subcontractor shall submit data, drawings, and other submittals specified. If the Contractor determines the Subcontractor's submittal to be incomplete or unacceptable, the Subcontractor shall make a complete and acceptable submittal to the Contractor by the second submission of a submittal item.

The Subcontractor shall be responsible for advising the Contractor of any submittal that may be delayed and which might, if further delayed, extend completion of the project.

Section Includes: Work includes, but is not limited to:

The preparation, transmittal and delivery of documents by the Subcontractor to the Contractor as required in the "Submittals" subdivision of the specification section and as provided on the Vendor Data Schedule.

Related Sections: General Provisions, Special Conditions, Drawings and Vendor Data Schedule and other sections of these specifications apply to this section.

REFERENCES:

The following documents, including others referenced therein, form part of this Section to the extent designated herein.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Y 14.1 Drawing Sheet Size and Format

SUBMITTALS:

General Procedures: Vendor data, whether prepared by the Subcontractor or Subcontractor's subtier or supplier, shall be submitted as instruments of the Subcontractor. Therefore, prior to submittal, the subcontractor shall ascertain that material and equipment covered by the submittal and the contents of the submittal itself, meet all the requirements of the subcontract specifications, drawings, or other contract documents.

Each submittal shall contain identification for each separable and separate piece of material or equipment, and literature with respect to the information provided in the specification and on the Vendor Data Schedule. Submittals shall be numbered consecutively for each different submittal.

Vendor Data Schedule: Vendor data required by the specification sections to support construction and operation of the project is identified on a Vendor Data Schedule. ~~The Vendor Data Schedule is an attachment to the Specification.~~ The Vendor Data Schedule provides a tabular listing by item number, drawing or specification reference, and description of the item or service. The type of submittal is identified by a "Vendor Data Code", and the time required to submit the item is identified by a "When to Submit" code. An "Approval" code specifies whether the submittal is for Mandatory Approval or for Information Only. One copy of routine paper or electronic file submittals is required; additional copies may be required by the Vendor Data Schedule. Electronic file submittals are preferred. Submittals that can not be scanned or provided electronically, such as large shop drawings, ~~which is preceded by the number of copies to be included with the submittal. Routine submittals~~ will require 6 copies for Mandatory Approval and **4** copies for Information Only. ~~A column is included to indicate if receiving inspection is required.~~

Or Equal Material or Equipment Submittals: All "or equal" materials, equipment or systems shall be identified and submitted for approval as required by the General Provisions.

An "or equal" submittal shall contain as a minimum all operating and physical parameters necessary to show that the material or equipment is equivalent to the specified material or equipment. All parameters shall be specifically identified by the submitter in the proposal. Exceptions or differences between the specified item and the "or equal" item shall also be identified.

If an "or equal" material, equipment or system is approved, the Subcontractor shall be responsible backup material necessary to include the material, equipment or system in the technical documents. In most cases this includes "red lining" a set of design drawings, and specifications to provide an "Approved for Construction" set of specifications and design drawings which incorporate the changes caused by the "or equal" item. These "red line" drawings shall be submitted prior to use of the "or equal" item. Any calculations or other backup material necessary to show that changes are adequate shall be included with the "red line" drawings and specifications.

~~Construction~~ Vendor Data Transmittal and Disposition Form 431.13: All vendor data shall be submitted to the Contractor using the ~~Construction~~ Vendor Data Transmittal and Disposition Form. Only one Vendor Data Submittal line item per transmittal and disposition form is acceptable. The form provides the Subcontractor a convenient method to submit vendor data and provides the Contractor a means of dispositioning the submittal. The Subcontractor shall list the Vendor Data Schedule item number, drawing or specification number, submittal status (e.g. Information Only, Re-submittal, or Or-equal submittal by

placing the quantity enclosed in the space) and the item description.

Disposition by the Contractor: The Contractor's comments and required action by the Subcontractor will be indicated by a disposition code on the submittal. The disposition codes will be classed as follows:

(A) "Work May Proceed." Submittals so noted will generally be classed as data that appears to be satisfactory without corrections.

(B) "Work May Proceed ~~Subject to~~ with Comments Incorporat~~ioned of Comments~~." This category will cover data that, ~~which,~~ with the correction of comments noted or marked on the submittal, appear to be satisfactory and require no further review by the Contractor prior to construction. ~~Revised drawings shall be provided upon request.~~

(C) "Work May NOT Proceed. Revise and Resubmit." Submittals so dispositioned will require a corrected resubmittal for one of the following reasons.

1. Submittal requires corrections, per comments, prior to final review.
2. Submittal data incomplete and requires more detailed information prior to final review.
3. Submitted data does not meet specification requirements.

(D) "Accepted for Use. ~~Received for~~ Information Only Submittal." Submittal so dispositioned will generally be classified as Information Only for as-specified material and equipment.

Mandatory Approval code vendor data will be reviewed by the Contractor and receive an **A,** B, or C disposition. ~~Information Only submittals will receive a D disposition. A, B, and C coded dispositioned submittals will be returned to the Subcontractor. D dispositioned submittals will not be returned to the Subcontractor.~~ The Contractor may provide internal review of Information Only submittals. In the event that comments are generated on an Information Only submittal, the submittal may be ~~re~~-dispositioned B or C code and returned to the Subcontractor for appropriate action. ~~Acknowledgment of receipt of dispositioned vendor data by the subcontractor will not be required~~Information Only submittals without comments will receive a D disposition.

All submittals will be returned to the Subcontractor. Acknowledgment of receipt of dispositioned vendor data by the Subcontractor will not be required.

The Contractor will return dispositioned submittals with reasonable promptness. Subcontractor shall note that a prompt review is dependent on timely and complete submittals in strict accordance with these instructions.

PART 2--PRODUCTS (SUBMITTAL REQUIREMENTS)

EQUIPMENT DATA:

Where specifically required by other sections, equipment data shall be provided. **As** applicable and except as otherwise specified, equipment data shall include the manufacturer's name and address, the model number, and specific information on performance, operating curves and data, ratings, capacities, characteristic efficiencies, catalog data, equipment dimensions, evidence of compliance with safety and performance standards, and other data required to fully describe the equipment. Data shall be submitted in sets covering complete systems or functioning units. The data shall also be identified with the tag number of the equipment or device for which the data applies.

INSPECTION AND TEST PROCEDURES:

Where specifically required by other sections, inspection and test procedures shall be provided. Inspection and test procedures shall include, as applicable: description of item or items involved, inspection or testing to be performed, a listing of testing agency and technical personnel to be used, description of equipment and facilities to be used, test prerequisites, test methods, test evaluation and acceptance criteria, safety precautions, sign-off requirements, methods for control and calibration of measuring and test equipment, proposed test record form, references to applicable portions of the subcontract documents, and detailed procedures, methods, and criteria for evaluation and acceptance. Test procedures shall be prepared in accordance with ~~Article SC-5 "QUALITY ASSURANCE" of the Special Conditions~~ the Subcontract Requirements Manual, PRD-5014 "Test Control".

INSPECTION AND TEST REPORTS:

Where specifically required by other sections, inspection and test reports shall be provided within 10 working days of such inspection or test. Inspection and test reports shall include, as applicable: identification of material or item inspected, inspection data, functional test data, date(s) and place(s) of inspection/tests, names of agencies and technicians involved, references to procedures and methods used, references to applicable portions of the subcontract documents, names of persons evaluating test results, identification of work failing to meet inspection/test acceptance criteria, and detailed description of corrective action taken.

INSTALLATION, APPLICATION, AND ERECTION INSTRUCTIONS:

Installation, application, and erection instructions shall be provided where specifically required by other sections. Installation, application, and erection instructions shall be clear, concise, and detailed, and shall utilize drawings and pictures to the extent necessary. The instructions shall include procedures for delivery acceptance, unpacking, inspection,

repacking, storage, handling, preparation of supporting work, assembly, and incorporation of the material/equipment into the work. The instructions shall include sequences, precautions, and tolerances.

In general, the Contractor's Representative will inspect the work to the criteria and instructions prescribed in the manufacturer's installation, application and erection instructions. The Subcontractor shall not deviate from the written instructions without prior written approval and direction from the manufacturer; such approval and direction shall be submitted to the Contractor as an attachment to the manufacturer's installation, application and erection instructions.

MATERIAL AND EOUIPMENT LISTS:

Where specifically required by other subdivisions, material and equipment lists shall be provided. Material and equipment lists shall be complete for the work specified under the subdivision and shall include all materials, products, equipment, and fixtures, including consumables. Lists shall include manufacturer's name and address, trade or brand name, local supplier's name and address, unit quantities and catalog numbers required to fully describe the item.

OPERATION AND MAINTENANCE (O&M) MANUALS:

Where specifically required by other sections, operation and maintenance manuals shall be provided.

Contents: O&M manuals for manufacturer's standard items shall, unless otherwise specified, be the standard publication issued for the product by the manufacturer.

PRODUCT DATA:

Where specifically required by other sections, product data shall be provided. Product data shall include descriptive material, such as catalog data, diagrams, color charts, and other data published by the manufacturer, as well as evidence of compliance with safety and performance standards. To demonstrate conformance to the specified requirements; catalog numbers alone will not be acceptable. The data shall include the name and address of the nearest service and maintenance organization that regularly stocks repair parts.

Product data submittals shall reference the applicable subdivision and drawings, and be complete for each item or unit of work.

SHOP DRAWINGS:

Where specifically required by other sections, shop drawings shall be provided. Each shop drawing submittal shall be complete and shall be accompanied by technical and performance

data as necessary to fully illustrate the information in the shop drawings, or cross referenced to such data contained in previous submittals. Unless otherwise specified, submittals shall consist of black-line printed copies. Hard copies and an electronic copy shall be submitted where required by other specification sections. Electronic copies of CAD generated drawings shall be provided in a form which will transfer to the Contractor's software using IGES or a custom software provided by the Subcontractor. Sepia type prints are not acceptable. One set of copies will be returned to the Subcontractor marked to show the required corrections or approval.

All equipment or other devices shall be identified on the shop drawings by the tag number indicated on the design drawings. The Subcontractor shall identify all equipment and devices with tags or labels in accordance with the requirements specified in the respective subdivision.

The following additional submittals shall be required as indicated on the Vendor Data Schedule:

Redline Drawings: Copies of the shop drawings shall be updated to include all changes or modifications made during construction and to reflect the actual conditions of construction. Each drawing shall be marked "As-Built" and be signed by the Subcontractor representative and shall be suitable for XEROX copying or microfilming.

Title Block and Identification: On each shop drawing, a 1-1/2 **x** 2-1/2 in. space shall be provided for the Contractor's review status stamp. Each shop drawing shall include a title block showing:

Project name and location

Name and address of Subcontractor or manufacturer as applicable

Date, scale of drawings, unique drawing identification number, and referenced design drawing number

Subcontractor's review and approval stamp or signatures

Revision record including signatures and dates.

Preparation and Size: Details and information shall be clearly drawn, dimensioned (including tolerances), noted, cross referenced and shall be of such quality as to ensure legible B (11 **x** 17 in.) size photocopy reproductions from microfilm (by others). Drafting and drawing standards shall be consistent with the practices established by ANSI or other acceptable standards and as specified herein:

Where applicable, views shall be oriented so that plant north faces to the left or up

Use of abbreviations shall be avoided where space permits spelling in full; if used, abbreviations shall be described in a legend on the drawing.

Types: Shop drawing shall be of the specific types specified in the respective subdivisions. If a specific type is not specified, drawing shall be the type most commonly required for the specific class of work subject to the Contractor's approval. The most commonly required types of shop drawings and drawing content (as applicable) are described hereinafter.

Wiring Diagrams: Shall identify all terminals, terminal blocks, and wires with wire numbers and colors. All wires within enclosures and all wiring connections to externally located equipment and devices shall be shown. For simple installations, wiring diagrams and control diagrams may be combined onto a common drawing.

SPECIAL PACKAGING, HANDLING, OR STORAGE PROCEDURES:

Where specifically required by other sections, special packaging, handling, rigging, shipping, storage, or preservation procedures shall be provided. These procedures shall contain the following minimum requirements as applicable:

Measures taken to prevent damage during transit

Detailed description of container design

Overall dimensions and approximate weight of container and contents

Recommended method for off-loading

List of required special off-loading devices

Special instruction for proper packaging and preventative maintenance during storage at the site

Special instructions for marking

Safety code labels, if applicable.

PART 3--EXECUTION (NOT APPLICABLE)

END OF SECTION 01300

SECTION 02062--DEMOLITIONAND REPAIRS

PART 1--GENERAL

SUMMARY:

Section Includes: Work includes, but is not limited to:

Demolition as shown on the drawings

Saw cutting and removal of asphalt paving

Salvage of identified items and materials

Removal of resulting rubbish and debris.

SUBMITTALS:

No submittals required.

PROJECT/SITE CONDITIONS:

Condition of Structures or Facilities: Conditions existing at the time of inspection for bidding purposes will be maintained insofar as practicable. Actual conditions may vary slightly due to operations, which may occur prior to start of demolition work.

Protection: Ensure safe passage of persons in the vicinity of the demolition area. Conduct operations to prevent injury to adjacent buildings, structures, other facilities and persons. Provide and erect any necessary temporary enclosures, barricades, walkways, shoring, bracing, etc., to ensure that safe conditions will exist.

Dust Control: The amount of dust resulting from demolition shall be controlled to prevent the spread of dust to occupied portions of the construction site and to avoid creation of a nuisance in the surrounding area. Use of water will not be permitted when it will result in, or create, hazardous or objectionable conditions such as ice, flooding and pollution.

Burning: The use of burning at the project site for the disposal of refuse and debris will not be permitted.

Use of Explosives: Use of explosives will not be permitted.

PART 2--PRODUCTS

MATERIALS:

Disposition of Removed Equipment and Materials: The Government will retain title to all equipment and materials removed by the work. Items which are to be reused under this Subcontract shall be removed and stored as indicated below. Materials designated as scrap shall be promptly disposed of as directed by the Special Conditions. Surplus material shall be disposed of as directed in the Special Conditions (SC-16).

PART 3--EXECUTION

GENERAL:

All demolition and repair work shall be done in a neat and orderly manner without any damage to existing facilities not directly involved under this Subcontract. The Subcontractor shall be responsible for all damage to existing buildings or facilities caused by his operations under this Subcontract.

POLLUTION CONTROLS:

Use temporary enclosures and other suitable methods to limit dust, spread of contamination, or spread of hazardous materials beyond the work area.

EXISTING STRUCTURES:

General: Existing structures shall be removed as indicated on the drawings.

Miscellaneous: All areas disturbed or demolished shall be patched and/or painted to match existing adjacent areas.

CLEAN UP:

Debris and rubbish shall be removed from the demolition areas. Debris shall be removed and transported in a manner that prevents spillage on streets or adjacent areas. Hauling and disposal shall comply with the Special Conditions (SC-16).

FIELD QUALITY CONTROL:

Surveillance will be performed by Contractor's Representative to verify compliance of the work to the drawings and specifications.

END OF SECTION 02062

SECTION 02200--EARTHWORK

PART 1--GENERAL

SUMMARY:

Section Includes: Work includes, but is not limited to:

Clearing as required

Excavating all materials encountered, of every description, for completion of the Subcontract as shown on the drawings and as specified herein. Work includes trenching, excavating for concrete ditches, culverts, evaporation pond, headwalls, endwalls, and manhole

Backfilling and grading of all excavations for piping, concrete ditches, manhole, around headwalls and endwalls, etc.

Subgrade preparation for lined evaporation pond

Surface water and erosion control measures

Installing a locator ribbon above utilities installed under this Subcontract

Compacting all backfill as specified herein

Finish grading and grading for surface drainage.

REFERENCES:

The following documents, including others referenced therein, form part of this Section to the extent designated herein.

AMERICAN ASSOCIATION OF STATE HIGHWAY TRANSPORTATION OFFICIALS (AASHTO)

AASHTO	Standard Specifications for Transportation Materials and Methods of Sampling and Testing
AASHTO M145	Recommended Practice for the Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes
AASHTO T11	Standard Method of Test for Materials Finer Than 75 Micrometer (No. 200) Sieve in Mineral Aggregates by Washing

AASHTO T27	Standard Method of Test for Sieve Analysis of Fine and Coarse Aggregates
AASHTO T99	Standard Method of Test for the Moisture-Density Relations of Soils Using a 5.5-lb (2.6-kg) Rammer and a 12 in. (305 mm) Drop
AASHTO T238	Standard Method of Test for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)

CODE OF FEDERAL REGULATIONS

29 CFR 1926	OSHA General Industry Safety Standards, Subpart P

IDAHO TRANSPORTATION DEPARTMENT (ITD)

SSHC	Standard Specification for Highway Construction, 1999

Related Sections:

02742 Plant Mix Patching
02598 Pond Liner
03301 Cast In Place Concrete

SUBMITTALS:

Submittals include, but are not limited to the following:

No vendor data required for this section unless an "or-equal" item is proposed.

See Section 01300, Submittals and the Vendor Data Schedule for additional submittal requirements.

PART 2--PRODUCTS

MATERIALS:

Satisfactory Soil Materials: Satisfactory soil materials are defined as those complying with AASHTO M145, soil classification Groups A-1, A-2-4, A-2-5, and A-3.

Unsatisfactory Soil Materials: Unsatisfactory soil materials are those defined in AASHTO M145 soil classification Groups A-2-6, A-2-7, A-4, A-5, A-6, and A-7; also peat and other highly organic soils.

Backfill and Fill Material: Excavated material shall be used as fill material. "Satisfactory" soil materials free of clay, rock, gravel larger than 3 in. in any dimension, debris, waste,

frozen materials, vegetable and other deleterious matter. If required, select pit run gravel is available at the CFA and TRA gravel pits. Gravel pit material and use of the gravel pits shall be at no cost to the Subcontractor. Upon completion of operations involving fill material removal, the Subcontractor shall grade and reshape the disturbed areas. Sloped surfaces shall meet the requirements of OSHA 29 CFR 1926.

Base Course Material: Naturally or artificially graded mixture of 3/4 in. maximum size crushed gravel, crushed stone, natural and crushed sand. Material shall meet the requirements of ITD subsection 703.04.

Buried Pipe Locator Ribbon: Ribbon shall be 3 in. wide and shall be red for all electrical conduits, electrical cables, and telephone cables. Yellow ribbon shall be used for all buried pipelines. Orange ribbon shall be used on cathodic protection. Ribbon shall be tape manufactured by Reef Industries or Allen Markline or equal and shall have metal foil which is completely encased in plastic so as to be unaffected by cathodic protection systems and can be easily detected by metal detectors. The ribbon shall be printed with the manufacturer's standard wording, "CAUTION ELECTRIC LINE BURIED BELOW," for all electrical conduits, phone lines, etc., "CAUTION BURIED PIPELINE BELOW," for all buried pipelines, and "CAUTION CATHODIC PROTECTION," for all buried cathodic protection systems.

PART 3--EXECUTION

EXCAVATION:

Earth Excavation: Earth excavation includes removal and disposal of pavements and other obstructions visible on ground surface, underground structures and utilities indicated to be demolished and removed, soil material of any classification, and other materials encountered that are not classified as rock excavation or unauthorized excavation.

> Hand Excavation: Any excavation within 5 feet horizontally or 2 feet vertically of marked underground energized or pressurized cables or piping not present in a concrete ductbank shall be done by hand.

Rock Excavation: No rock excavation is required.

Unauthorized Excavation: Unauthorized excavation consists of removal of materials beyond indicated elevations or dimensions without specific direction by the Contractor. Unauthorized excavation, as well as remedial work directed by the Contractor, shall be at the Subcontractor's expense.

Structural: Excavations for such structures as headwalls and endwalls shall be made to the depths shown on the drawings and of sufficient width to allow adequate room for setting and removing forms, installing accessories and inspection. Where concrete structures are to be

constructed on material other than rock, care shall be taken to prevent disturbing the bottom of the excavation. Excavation to final grade shall not be made until just before concrete forms are to be placed therein.

Under Pavement:

Crushed Gravel Leveling Course: Prior to placement of the crushed gravel base, the existing subbase shall be stripped of all vegetation, brought to optimum moisture content, and compacted to at least 90% maximum density as determined by the AASHTO T99.

Furnish and place crushed gravel as a leveling course in accordance with the plans and specifications. Crushed gravel shall be mixed by motor graders or other approved equipment until the mixture is uniform throughout. During the mixing, water shall be added in an amount necessary to facilitate compaction. Use watering equipment specified in this specification.

Under Concrete Ditches:

Prior to placement of the concrete, the existing subbase shall be graded and stripped of all vegetation, brought to optimum moisture content, and compacted to at least 92% maximum density as determined by the AASHTO T99.

Trenches: Trenches shall be of sufficient width to provide adequate room for workmen to perform any necessary service to the materials or items being installed therein and to permit proper compaction of the backfill.

Grade: The bottom of pipe trenches shall be graded to allow for a minimum of 4 in. of compacted sand bedding beneath the pipe. Bell holes shall be shaped so that pipe will be uniformly supported for its entire length on the compacted sand backfill.

Pond Surface Preparation: The geotextile and lining installation shall not begin until after a proper base has been prepared to accept the HDPE liner system. The base surface shall be smooth and free from sharp objects that could puncture the lining. All vegetation, roots and grass must be removed. Any cracks or voids shall be filled.

Pond grades were originally excavated in 2001. Minor dressing of the interior slopes and pond floor is required to re-establish design grades and prepare the subgrade in accordance with the liner manufacturer's recommendations. **As** a minimum, the interior slopes shall be compacted by 2 to 3 passes with a Caterpillar D-6 dozer (or one of equal or larger size and weight) and graded or dressed to remove dozer tracks. The pond floor shall be compacted as specified in the "compaction" section and rolled with a smooth drum roller to form a smooth, firm base. The subgrade surface shall be made uniform as per the plan drawings. Abrupt changes in elevation grade of the prepared surface are to be avoided. ~~The subgrade surface~~

~~shall be made uniform as per the plan drawings. Abrupt changes in elevation grade of the prepared surface is to be avoided. The surface shall be rolled with a smooth drum roller to form a firm base and compacted and shaped in accordance with the liner manufacturer's recommendations.~~

Acceptance of the subgrade surface by the liner manufacturer's representative is required before proceeding with the installation of the liner, see form attached at the end of specifications. This acceptance will be limited to the amount of area that may be lined during a particular work shift. Direction and control of any subsequent repairs to the subgrade, including the subgrade surface, shall remain the responsibility of the Subcontractor. Subgrade acceptance by the Contractor does not constitute acceptance of construction variables, such as moisture content and compaction.

Stockpiling; and Disposal: Excavated material that is suitable and required for backfilling, or grading, shall be piled in an orderly manner a sufficient distance from the edge of the excavation, but in no case closer than 2 ft, and so located that it will not interfere with normal vehicular or pedestrian traffic. Excavated materials to be used for backfill shall be kept free from vegetation and other objectionable materials. Excavated materials not required or not approved for backfilling, grading or topsoil, shall be stockpiled. Unused excavated earth and combustible materials shall be hauled to areas designated by the Contractor and disposed of in a manner specified in the Special Conditions.

Unstable Soils: If wet or otherwise unsatisfactory soil is encountered in an excavation, at or below the excavation line, it shall be brought to the attention of the Contractor and removed as directed in accordance with Article 38, "Differing Site Conditions," of the General Provisions. The bottom of the excavation shall then be brought to the required grade with compacted backfill as specified hereinafter. Excavation of unstable soil resulting from the Subcontractor's neglect to keep the excavated opening dry, and other over depth excavation not required to satisfactorily complete the work, shall be brought up to the required grade with concrete or compacted backfill as specified hereinafter at the Subcontractor's expense.

Shoring; and Bracing: The sides of all excavations shall be sloped or securely shored and braced in accordance with OSHA 29 CFR 1926, Subpart P.

Control of Water: All excavations shall be kept free of standing water. The Subcontractor shall furnish, install and operate the equipment required to keep excavations free from water at all times. Water shall be disposed of in a manner that will not cause injury to property.

BACKFILL OR FILL:

General: The excavations shall be cleared of all trash and debris prior to backfilling or filling. All backfill or fill material shall be free from trash, organic matter and frozen particles. Backfilling or filling shall be done only when approved by the Contractor. In

excavations that are shored, shoring and formwork shall be removed or raised as backfill or fill is placed.

Under Headwalls, Slabs or Pavement: Backfill or fill materials under headwalls, endwalls, slabs, and concrete including fill for manholes shall be compacted fill material as specified in the "Materials" section, except that the last 2 in. of such fill shall be compacted base course material. Backfill or fill materials under asphalt pavement shall be compacted fill material as specified in the "Materials" section, except for paving in a roadway or driving surface. Asphalt paving through roadway and driveway sections shall have the last 4 in. of such fill be compacted base course material.

Pipelines: Bedding for piping and buried tanks shall be compacted sand or other approved granular material unless otherwise shown on the drawings. Bedding material shall extend from a minimum of 4 in. beneath the pipe to a minimum cover of 4 in. The remainder of the trench or excavation shall be backfilled as specified hereinafter.

Overdepth Pipeline Excavation: Where pipe trenches are excavated to an overdepth due to the presence of rock, unstable soil or other unsuitable material, the overdepth shall be backfilled to required grade with compacted sand or other approved granular material.

Placement: Concentrated dumping of backfill or fill material into excavations will not be permitted. No water shall be used for placing, settling or compacting backfill or fill except to obtain optimum moisture content. All material must be placed in uniform layers not to exceed 8 in. loose measurement and brought up simultaneously and evenly around structures and equipment such as culverts, manholes, and pipe. Backfill or fill around piping, and at least 4 in. over, shall be hand placed and compacted. Care shall be taken when backfilling, filling, or compacting around any buried items or dampproofed walls to prevent injury to the item being covered and to prevent piercing or rupturing the insulation, coating or dampproofing membrane. Loose backfill or fill may be placed as specified hereinafter.

Compaction: Unless otherwise indicated on the drawings or specifications, compact all backfill and fill material under slabs, roads, and other surfaced areas, around foundation walls, culverts, and other similar structures and to at least 4 in. compacted depth above all piping in trenches. Unless otherwise indicated, all "compacted" backfill or fill shall be compacted to at least 95% of maximum density at optimum moisture content as determined by AASHTO T99. Each 8-in., maximum, loose measurement lift shall be compacted before the next lift is placed thereon. Compacted backfill or fill density and moisture content may be measured by the Contractor at any location and depth. Sections of backfill or fill failing to meet the minimum compaction requirements shall be corrected prior to placement of subsequent lifts. No heavy equipment shall be allowed within 5 ft of a structure or the foundation of **any** structure. No heavy equipment shall be allowed over piping until a minimum of 24 in. of backfill has been compacted over the piping.

Locator Ribbon: The locator ribbon shall be placed in a zone 6 to 12 in. from the ground surface directly over the utility during the backfill and compaction operation.

FIELD QUALITY CONTROL:

Surveillance will be performed by the Contractor's Representative to verify compliance of the work to the drawings and specifications.

END OF SECTION 02200

SECTION 02742--PLANT MIX PATCHING AND PAVING

PART 1--GENERAL

SUMMARY:

Provide all work, operations and material required to construct plant mix paving and patching in accordance with the project drawings and these specifications.

Related Sections include the following:

02200 Earthwork

Section Includes: Work includes, but is not limited to:

Paving areas as designated on the design drawings

Patch all paved areas where excavation occurred within plant mix pavement

Furnish and apply tack coat where applicable

Haul, place and compact asphalt pavement.

REFERENCES:

The following documents, including others referenced therein, form a part of this Section to the extent designated herein.

AMEFUCAN ASSOCIATION OF STATE HIGHWAY TRANSPORTATION OFFICIALS (AASHTO)

AASHTO	Standard Specifications for Transportation Materials and Methods of Sampling and Testing

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 2922	Standard Test Methods for Density of Soil and Soil-Aggregate In Place By Nuclear Methods (Shallow Depth)

IDAHO TRANSPORTATION DEPARTMENT (ITD)

ITD SSHC	Standard Specifications for Highway Construction, 1999
ITD	Field Test Manual, Part I, Sampling and Test Methods

SUBMITTALS:

Submittals include, but are not limited to the following:

Mix Design: Submit results of the plant mix design test reports, including sieve test reports for the aggregates to be used on this project.

Batch Tickets: Plant mix batch tickets shall be provided to the Construction Management Point of Contact (POC) for each truckload at the time of delivery. Tickets shall show, at a minimum, the time, temperature, and weight for each load.

SYSTEM DESCRIPTION:

Mix Design: The plant mix design shall be in accordance with the SSHC.

Composition of Mixture: The plant mix shall be composed of a mixture of aggregate, filler if required, and asphalt. The plant mix shall be Class III in accordance with SSHC Section 405. The mix design shall be tested by an independent test laboratory and shall meet the following criteria:

HVEEM Method: (See 405.02 of SSHC)

Class III Pavements:

Stability:	~~35~~0 minimum
Immersion Compression:	85% minimum
Air Voids:	3% to 5%
Fine Aggregate Angularity:	~~45~~0

Aggregate shall comply with SSHC Section 703 and sieve test reports shall be submitted for gradation information. ~~Aggregate shall be provided in separate stockpiles as required in SSHC Section 703.05.~~

The mix design test results, including sieve test reports and the design mix shall be in effect unless modified in writing by the Contractor.

Should a change in sources of material be made, a new mix design shall be established before the new material is used; when unsatisfactory results or other conditions make it necessary, the Contractor may establish a new mix design.

QUALITY CONTROL:

Regulatory Requirements: (Codes and Standards): Comply with provisions of the following codes and standards, unless otherwise specified herein. Idaho State Specifications are

available for inspection at offices of the Idaho Transportation Department, Rigby, Idaho, and the Department of Energy (DOE), Idaho Operations Office.

AASHTO	Standard Specifications for Transportation Materials and Methods of Sampling and Testing
SSHC	Standard Specifications for Highway Construction (SSHC), Current Edition
ITD	Field Test Manual, Part I, Sampling and Test Methods

SITE CONDITIONS:

Environmental Limitations: Plant mix material shall not be placed on a wet or frozen surface, when the air temperature is below 40° F, or when weather or surface conditions otherwise prevent the proper handling or finishing of the plant mix material.

PART 2--PRODUCTS

Asphalt Binder: PG 58-28 in accordance with Section 702 of the SSHC and AASHTO MP-I

Crushed Gravel Aggregate: Aggregate for plant mix pavement shall be in accordance with (SSHC) Section 703. The master gradation for aggregate for the ½ in. plant mix pavement shall be as follows:

Sieve	Percent Passing
~~3/4~~¾"	100
~~1/2~~½"	~~90~~5 – 100
3/8"	75 - 90
No. **4**	~~5~~10 - ~~6~~175
No. 8	375 – ~~47~~60
No. 30	15 - 35
No. 50	1~~8~~0 - ~~26~~25
No. 200	~~5~~4 - ~~10~~8

Coarse Aggregate: Sound, angular crushed stone or crushed gravel.

Fine Aggregate: AASHTO M 29, sharp-edged, natural sand or sand prepared from stone, gravel, or combinations thereof.

Tack Coat: The tack coat shall be an emulsified asphalt, CSS-1 diluted with one part water to one part emulsified asphalt, meeting the applicable requirements of Section 702 (SSHC).

Plant Mix Patching: Dense, hot-laid, plant mix complying with the SSHC. Provide mixes with a history of satisfactory performance at the INEEL.

PART 3--EXECUTION

SUBBASE AND BASE COURSE:

General: Construct crushed gravel base, including the preparation of the subbase upon which the gravel is to rest, in accordance with Section 02200, "EARTHWORK."

EXAMINATION:

Verify that the subgrade is compact and follows the lines and grades shown on the plan. Proceed with paving only after unsatisfactory conditions have been corrected.

SURFACE PREPARATION:

The Subcontractor shall saw cut the existing asphalt pavement back 6 to 10 inches from the edge of excavation in a neat, vertical straight line. Any fractured, heaved, undermined or otherwise damaged asphalt beyond the **6** to 10 inch offset cut shall be "squared out" as directed by the Contractor's Representative and repaved.

TACK COAT:

Immediately prior to replacing any plant mix, the Subcontractor shall paint all edges of the old mat with an asphalt tack coat. Distribute at rate of 0.10 gal per **sq** yd of surface.

PLACING AND FINISHING PLANT MIX PAVEMENT:

General: The plant mix shall then be spread uniformly and without segregation across the entire width of the area where the surfacing has been removed and where the patch is required. It shall be spread to such a depth that when compacted to its maximum density, the patched surface will match the existing surface. The plant mix shall be compacted to at least 92% standard density. The temperature of the plant mix shall not drop more than 20 deg F between the hot plant and the paver.

The Subcontractor shall "rake" all edges to ensure the availability of a sufficient number of fines to seal the joints.

FIELD OUALITY CONTROL:

Contractor Supplied Testing: The following tests may be performed by others at no cost to the Subcontractor:

1. AASHTO T238 (ASTM D 2922) for moisture-density relationship of base course in-place and plant mix in-place
2. Idaho T125 (Nuclear Densiometer) for plant mix in-place density

3. Idaho T87 for surface smoothness of finished pavement.

Surveillance will be performed by Contractor's Representative to verify compliance of the work to the drawings and specifications.

END OF SECTION 02742

SECTION 02598--POND LINER

PART 1--GENERAL

SUMMARY:

The Subcontractor shall supply all labor and materials required to provide a non-woven geotextile, high density polyethylene (HDPE) drainage net (geonet) and HDPE geomembrane liners for the evaporation pond complete and in accordance with the drawings and specifications.

Section Includes: Work includes, but is not limited to:

Furnish and install pond liners as shown on the drawings and this specification

Furnish and install pond drainage net as shown on the drawings and this specification

Furnish and install non-woven geotextile as shown on the drawings and this specification.

Related Sections:

02200 Earthwork

REFERENCES:

The following documents, including others referenced therein, form part of this Section to the extent designated herein:

AMEFUCAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

Non-Woven Geotextile:

ASTM D3776	Standard Test Method for Mass Per Unit Area (Weight) of Fabric
ASTM D4355	Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus)
ASTM D4491	Standard Test Methods for Water Permeability of Geotextiles by Permittivity
ASTM D4533	Standard Test Method for Trapezoid Tearing Strength of Geotextiles
ASTM D4632	Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
ASTM D4751	Standard Test Method for Determining Apparent Opening Size
ASTM D4833	Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products

ASTM D5261	Standard Test Method for Measuring Mass per Unit Area of Geotextiles

HDPE Geomembranes:

ASTM D638	Standard Test Method for Tensile Properties of Plastics
ASTM D1004	Standard Test Method for Initial Tear Resistance of Plastic Film and Sheeting
ASTM D1238	Standard Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer
ASTM D1505	Standard Test Method for Density of Plastics by the Density-Gradient Technique
ASTM D1603	Standard Test Method for Carbon Black in Olefin Plastics
ASTM D4218	Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique
ASTM D4437	Standard Practice for Determining the Integrity of Field Seams Used in Joining Flexible Polymeric Sheet Geomembranes
ASTM D4833	Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
ASTM D5199	Standard Test Method for Measuring the Nominal Thickness of Geosynthetics
ASTM D5596	Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics
ASTM D5994	Standard Test Method for Measuring Core Thickness of Textured Geomembranes
ASTM D6392	Standard Test Method for Determining the Integrity of Non-reinforced Geomembrane Seams Produced Using Thermo-Fusion Methods

HDPE Drainage Net:

ASTM D1505	Standard Test Method for Density of Plastics by the Density-Gradient Technique
ASTM D1603	Standard Test Method for Carbon Black in Olefin Plastics
ASTM D4218	Test Method for Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique
ASTM D4716	Standard Test Method for Constant Head Hydraulic Transmissivity(In-Plane Flow) of Geotextiles and Geotextile Related Products
ASTM D5034	Standard Test Method for Breaking Strength and Elongation of Textile Fabrics (Grab Test)
ASTM D5035	Standard Test Method for Breaking Force and Elongation of Textile Fabrics (Strip Method)
ASTM D5199	Standard Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes

SUBMITTALS:

Submittals include but are not limited to the following:

Quality Control Plan: Submit a quality control plan for fabrication and installation for approval. Specific details shall be shown where sealing around pipe penetrations and other structures.

Installation Plan and Shop Drawings: Submit plans, drawings and product data showing proposed panel layout including field seams, details, ballast and safety ladders.

Certification: Submit certification that the material supplied meets the Materials requirements.

As-Built Drawings: Submit as-built redline drawings showing actual geomembrane panel placement and seams including typical anchor trench details.

Test Reports: Submit test procedures and reports for liner fabrication and seam inspection.

Qualifications: Submit certification of personnel performing fabrication and installation of the fabric. Submit the names of the projects and references, which document the subcontractor's qualifications.

Warranty: Submit pond liner warranty.

See Section 01300, Submittals and Vendor Data Schedule for additional submittal requirements.

OUALITY CONTROL:

The installation Subcontractor shall be approved by the manufacturer of the liner materials. A representative of the company furnishing the liners shall be present during the entire installation procedure and shall provide technical assistance for the installation of the lining.

The Subcontractor shall be an established firm regularly engaged in manufacturing and installing liner systems for the past 5 years installing a minimum of 5,000,000 square feet of HDPE lining.

The Subcontractor shall provide documentation of an approved Subcontractor Quality Control Plan for the fabrication and installation of the flexible membrane liners.

Documentation shall be submitted with the liner certifying compliance with the Materials section of this specification.

DELIVERY. STORAGE AND HANDLING:

Delivery, storage and handling of the materials shall conform to the manufacturer's recommendations and shall be done in such a manner as to prevent damage to any part of the work.

Liner materials shall be supplied in rolls wrapped in covers and marked or tagged with the roll number. Each material roll shall include information to demonstrate material traceability through written documentation from the manufacturer and transport company. At a minimum, this information shall include the manufacturer's name, product identification, lot number and roll dimension (area and width). During shipment and storage, the liner materials shall be protected from mud, dirt, UV exposure, dust, puncture, cutting, or other damaging or deleterious conditions. Protective wrappings which are damaged shall be repaired or replaced, as necessary.

PROJECT/SITE CONDITIONS:

The purpose of this work is to install a double lined containment system with leak detection for a new earth pond to contain stormwater runoff for a duration of 20 years.

The maximum depth of the liquid in this open-air pond will be approximately 15-ft. Liquid levels will vary due to evaporation and variations in flow. The pond will be empty most of the time.

The temperature of the contained liquid will vary with the ambient temperature.

Refer to subcontract drawings for dimensions of the pond.

The pond is located at the Idaho National Engineering and Environmental Laboratory in southeast Idaho. The mean temperature at this location is 42' F, with a summer high of 100° F, and a winter low of -40' F.

The highest recorded winds are 80 mph.

WARRANTY:

Manufacturer shall provide a written 10-year prorated warranty on the HDPE liners. The installation shall be warranted against defects in workmanship for a period of 2 years from the date of geomembrane completion.

PART 2--PRODUCTS

MATERIALS:

Non-woven Geotextile: Prior to the liner installation, a non-woven geotextile shall be installed to protect the liner from the subgrade. The non-woven geotextile shall meet the minimum physical requirements indicated in Table 1 below.

Typical Properties	Test Method	Requirements (Typical Value/MARV)*
Grab Tensile Strength	ASTM D4632	415/380 lbs
Grab Elongation	ASTM D4632	65/50 %
Puncture Strength	ASTM D4833	280/240 lbs
Fabric Weight	ASTM D3776/D5261	**16** oz/yd^2
Trapezoidal Tear	ASTM D4533	165/145 lbs
Apparent Opening Size	ASTM D4751	140/100 US Std Sieve
Permittivity	ASTM D4491	1.00/0.70 sec^{-1}
Permeability	ASTM D4491	0.39/0.27 cm/sec
Water Flow Rate	ASTM D4491	65/50 gpm/ft^2
W Resistance (% retained after 500 hours)	ASTM D4355	70 % retained @ 500 hours

*"MARV" indicates minimum average roll values; calculated as the mean minus two standard deviations, yielding a 95% confidence level.

HDPE Geomembranes: The secondary geomembrane shall be HDPE, un-reinforced 60-mil nominal thickness, smooth both sides. Single-sided textured HDPE, 60-mil nominal thickness, shall be used for the primary geomembrane (textured side up).

The HDPE liner membrane shall be designed and manufactured specifically for the purpose of containment of liquids in hydraulic structures. It shall be manufactured from new, first-quality HDPE resin and shall meet the minimum physical requirements indicated in the Physical Properties table (Table 2). The resin used to produce the geomembrane shall be formulated to be resistant to chemical and ultraviolet degradation.

Boots for pipe penetrations shall be shop prefabricated and designed to fit site-specific conditions for the intended slope and size of the pipe. Boots shall be of the same material as the geomembrane.

Table-2 Minimum HDPE Geomembrane Liner Physical Properties

Typical Properties	Test Method	Requirements
Thickness-minimum average value (smooth HDPE)	ASTM D5199	60 mils
Thickness-individual minimum value (smooth HDPE)	ASTM D5199	54 mils
Thickness-minimum average value (textured HDPE)	ASTM D5994	60 mils
Thickness-individual minimum value (textured HDPE)	ASTM D5994	51 mils
Sheet Density (Min.)	ASTM D1505	0.94 g/cc
Carbon Black Content (Min.)	ASTM D1603/D4218	2 %
Tensile Properties (Min. Avg. Value) 1. Tensile Strength at Yield 2. Elongation at Yield	ASTM D 638, Type IV Gage length = 1.3 in.	 132 lb/in 13 %
Tear Resistance, (Min. Value)	ASTM D1004	45 lbs
Seam Properties 1. Shear Strength (Min.) 2. Peel Strength (hot wedge fusion) – Min Value 3. Peel Strength (fillet extrusion) – Min Value	 ASTM D4437 or D6392	 120 lb/in 90 lb/in 78 lb/in
Dimensional Stability, Percent Change Each Direction (Max.)	ASTM D1204, NSF Modified	+1.0 %
Puncture Resistance (Min. Value)	ASTM D4833	78 lbs
Carbon Black Dispersion, minimum 8 of 10	ASTM D5596	Category 1 or 2
Melt Index	ASTM D1238, Condition 190/2.16	1.0 8/10 min

Certified test results from the manufacturer showing that the HDPE meets or exceeds the material requirements shall be provided.

The sheeting shall be a flexible, durable, watertight product free of pinholes, blisters, holes and contaminants.

The HDPE drainage net shall be designed and manufactured specifically for the purpose of containment of liquids in hydraulic structures. It shall be manufactured from new, first-quality HDPE resin and shall meet the minimum physical requirements indicated in the Physical Properties table (Table 3).

Table-3 Minimum Drainage Net (Geonet) Physical Properties

Typical Properties	Test Method	Min. Requirements
Tensile Strength	ASTM D5034/5035	45 lb/in
Transmissivity	ASTM D4716	1 x 10^{-3} m^2/sec
Thickness	ASTM D5199	200 mils
Density	ASTM D1505	0.94 g/cc
Carbon Black Content	ASTM D1603/D4218	2 %

Possible HDPE suppliers include GSE Lining Technologies, Inc., National Seal Co., and Serrot Corp.

PART 3--EXECUTION:

SURFACE PREPARATION:

See pond surface preparation, under Section 02200--Earthwork.

FACTORY QUALITY CONTROL:

Receiving Inspection: When HDPE roll goods are received from the manufacturer, the roll numbers and production lot number given on the packing list shall be verified.

Rolls shall be inspected to assure rolls have not been visibly damaged during transit.

Random testing ~~shall~~ may be done by the Contractor to assure that the HDPE lining delivered meets project specifications for gauge, roll width, taper, positive crown, dimensional stability, and minimum tensile properties.

Fabrication and Inspection: In order to minimize field-seaming requirements during installation, individual rolls of HDPE shall be factory fabricated into large panels, to the extent possible. Factory panels will be fabricated with solvent or thermal welding. A 12-inch cross-sectional panel retainer shall be removed from each production run. This will be used for factory and field seam testing.

After the panel retains are cut, samples shall be tested for bonded seam strength (stress strength) and peal adhesion. All seam testing shall be performed as required by NSF Standard 54. Bonded seam strength tests for HDPE shall be done in accordance with ASTM D6392 (as modified in NSF Standard 54). Peel adhesion test for HDPE shall be conducted in

accordance with ASTM D6392 (as modified in NSF Standard 54). All seam strength test reports shall be furnished to the Contractor.

INSTALLATION:

GENERAL:

Materials and work which fail to meet the requirements of these Specifications shall be removed, disposed of, and replaced at the Subcontractor's expense.

GEOTEXTILE INSTALLATION:

The Subcontractor shall handle all geotextiles in such a manner as to ensure that they are not damaged. If necessary, use a smooth slip-sheet under the textile. Position the geotextile after deployment and remove the slip-sheet, if used.

Place geotextiles in a manner that prevents folds and wrinkles. Folds or wrinkles shall be pulled smooth prior to seaming. In the presence of wind, all exposed geotextiles shall be weighted with sandbags or equivalent. Sandbags shall be installed during placement and shall remain until replaced with overlying liner materials.

Geotextiles shall be cut using an approved geotextile cutter only. During geotextile placement, care shall be taken not to entrap stones, excessive dust, or moisture that could damage the geomembrane, or hamper subsequent seaming. Geotextiles shall be placed with the machine direction (long dimension) downslope or normal to the natural slope. After installation and immediately prior to placing overlying liner materials, the geotextile shall be examined over its entire surface to ensure that no potentially harmful foreign objects, such as needles, are present. Any foreign objects encountered shall be removed, or the geotextile shall be replaced.

After deployment, all geotextile shall be covered to prevent exposure to ultraviolet *(UV)* radiation (sunlight) within a maximum period of 14 days. If the geotextile is exposed for more than 14 days, a temporary cover may be deployed for the duration of the delay or samples may be submitted to an independent testing laboratory to ensure that detrimental levels of UV degradation have not occurred. Detrimental level of UV degradation is defined as greater than 10 percent loss of required geotextile properties listed in Table 1 for the following:

1. Grab strength
2. Trapezoidal tear strength
3. Puncture strength.

Joining Geotextiles: Edge of roll seams are not required to be sewn and shall be overlapped a minimum of **6** inches. End of roll seams are not required to be sewn and shall be overlapped

a minimum of 12 inches. No end-of-roll seams shall be allowed on slopes 6H: 1V and steeper. Overlaps shall be in the direction of flow with the upstream fabric on top of the downstream fabric.

On the pond floor, no horizontal seam shall be closer than 3 feet to the toe of the slope or other areas of potential stress concentrations. Areas to be seamed shall be clean and free of foreign material. Any holes or tears in the geotextile shall be repaired as follows: Remove any soil or other material which may have penetrated the tom geotextile. Replace tom areas and holes by placing a geotextile patch having dimensions of at least 12 inches greater than the tear or hole. The geotextile patch shall be sewn.

DRAINAGE NET INSTALLATION:

The Subcontractor shall handle all geonets in such a manner as to ensure that these materials are not damaged. Clean geomembrane surface prior to placing geonet. On slopes, geonet may be deployed over slipsheets with the roll at the top of the slope. ***An*** alternative method is to secure the geonet and then roll it down slope in a manner to continually keep it in tension. If necessary, position the geonet after deployment to minimize wrinkles and remove the slipsheet, if used.

In the presence of wind, all exposed geonets shall be weighted with sandbags or equivalent. Sandbags shall be installed during geonet placement and shall remain until replaced with primary liner material. Unless otherwise specified, geonets shall not be welded to geomembranes. Geonets shall only be cut using approved cutting tools. Protect underlying geosynthetics when cutting. The Subcontractor shall take any necessary precautions to prevent damage to underlying layers during placement of the geonet. During placement of geonets, care shall be taken not to entrap dirt or excessive dust that could cause clogging of the drainage system, and/or stones that could damage the adjacent geomembrane. Dirt or excessive dust entrapped in the geonet shall be cleaned prior to placement of the liner material on top of it. Excessive dust is defined as any thickness greater than 20 mils (0.02 inch) within the geonet. In this regard, care shall be taken with the handling of sandbags, to prevent rupture or damage of the sandbag. Tools shall not be left in the geonet.

Joining Geonets: Geonet panels shall be overlapped and tied side to side and end to end as recommended by the manufacturer. Acceptable tying devices include strings, plastic fasteners, or polymer braid. Tying devices shall be of contrasting color to the geonet for easy observation. Metallic devices are not allowed. No horizontal seams shall be allowed on side slopes except at roll ends. If more than one layer of geonet is installed, joints shall be staggered.

HDPE LINER INSTALLATION:

GENERAL:

Prior to beginning geomembrane installation, the Geomembrane Installer shall submit a plan describing the proposed size, number, position and sequence of geomembrane panel placement, and location of field seams.

Panel Placement and Seaming: The HDPE geomembrane liners shall be placed over the prepared surface and geotextile and drainage net as shown in the drawings, in such a manner as to assure minimum handling. The Subcontractor shall be responsible for surveying to control the location and placement of the liners. Control coordinates are shown on the plans.

Field panels shall be installed at the locations indicated in the Installer's layout plan, as approved or modified. Only as many field panels shall be deployed each day as can be continuously welded that same day.

The liner shall be installed in relaxed condition, free of stress or tension upon completion of the installation. Stretching the liner to fit is not permissible. Sufficient material (slack) shall be provided, to allow for geomembrane expansion and contraction.

Lap joints shall be used to seal factory fabricated panels of HDPE together in the field. Contact surfaces of the two sheets shall be wiped clean to remove all dirt, dust, moisture or other foreign materials. Field seams can be made by extrusion or hot wedge welding under the direction of the manufacturer.

The liner shall be attached to the concrete splash apron with an adhesive and a stainless steel strap. Details shall be submitted on the shop drawings. Special attention shall be given to all field seams especially around the concrete structures and pipe penetrations to assure water tightness.

The adhesive shall comply with WSD-6015 by Watersave Company Inc. or approved equal. Stainless steel shall comply with ASTM 276 and ASTM A240.

Placement Conditions: Geomembrane placement shall not proceed at an ambient temperature below 32° F or above 110° F as measured 6 inches above the geomembrane surface unless installation procedures approved by the BBWI Construction Manager are in place to address environmental conditions.

Geomembrane placement shall not be done during any precipitation, in the presence of excessive moisture (e.g., fog, dew), in an area of ponded water, or in the presence of excessive winds. For cold weather seaming, it is advisable to preheat the sheets with a radiant heater, or a hot air blower, or to use a tent in order to determine appropriate seaming conditions. No welding shall take place when it is snowing, sleeting, or raining.

Properties	Test Method	Test Frequency
Density	ASTM D792/D 1505	1 per Resin Batch
Melt Flow Index	ASTM D1238	1 per Resin Batch
Carbon Black Content	ASTM D1603/D4218	1 per Resin Batch

Results from testing shall be submitted to the Contractor.

The Installer shall comply with the following:

The Installer shall maintain on-site a sufficient number of spare operable seaming machines (at least one at all times) to ensure continuous operation

The equipment used for seaming shall not be likely to damage the geomembrane

The extruder shall be purged prior to beginning a seam until all heat-degraded extrudate has been removed from the barrel

The electric generator shall be placed on a smooth base such that no damage occurs to the geomembrane

Grinding shall be completed no more than 1 hour prior to seaming

A smooth insulating plate or fabric shall be placed beneath the hot welding machine after usage.

Visual Inspection: After welding, a close visual inspection of the seams shall be made. This is to be done as soon as possible after the weld has been completed. The inspection is to

include weld alignment. For extrusion welding, the weld thickness and profile is to be inspected.

Defective areas shall be marked and repaired. This inspection/repair process is to be carried out in a systematic manner as soon as possible to ensure that no defective area goes un-repaired.

NON-DESTRUCTIVE SEAM STRENGTH TESTING:

The Subcontractor shall perform trial weld testing and non-destructive seam testing of all field seams over their full length using vacuum box testing, air pressure testing (for fusion wedge welded seams only), or spark testing.

Trial Welds: Trial welds shall be performed on geomembrane samples to verify welding equipment operations and performance of seaming methods and conditions. No welding equipment or welder shall be allowed to perform production welds until equipment and welders have successfully completed trial welds. **A** minimum of two trial welds shall be performed per day or shift per welding apparatus, one made prior to the start of the work and one completed mid shift. Welds shall be made under the same surface and environmental conditions as the production welds (i.e., in contact with geomembrane subsurface and similar ambient temperatures).

Trial Weld Testing: Samples shall be at least five feet long and one foot wide with the seam centered lengthwise. Five, one-inch wide test strips shall be cut from the trial weld. Each of the specimens shall be quantitatively tested in the field for peel adhesion, and then for bonded seam strength (shear). **A** trial weld specimen shall pass when the results are achieved for both peel and shear tests as shown in these specifications. The break, when peel testing, occurs in the liner material itself, not through peel separation. Also, the break shall be ductile. Repeat the trial weld, in its entirety, when any of the trial weld samples fail in either peel or shear. Remaining samples shall be retained for future testing. For double-wedge welding, both welds shall be individually tested and both shall be required to pass in peel.

Tensiometer for Field Testing: Field testing shall be performed using a tensiometer with the following requirements:

Motor driven with jaws capable of traveling at measured rate of 2 inches per minute

Equipped with gauge which measures force in unit pounds exerted between jaws

Force Tech 5002 DPR portable tensile tester as furnished by Columbine International, Ltd., Placerville, **CA;** or approved equal.

Vacuum Box Testing: The equipment shall include two vacuum box assemblies consisting of the following: a rigid housing, a transparent viewing window, a soft neoprene gasket, attached to the bottom, a port hole or valve assembly, a vacuum gauge, a vacuum device equipped with pressure control, a rubber pressure/vacuum hose with fittings and connections, a soapy solution and an applicator.

Testing shall conform to the following procedure: brush a soapy solution on the geomembrane. Place vacuum box over the wetted seam area. Ensure that a leak-tight seal is created. Apply a vacuum of approximately 5 psi. Examine the geomembrane through the viewing window for the presence of soap bubbles for not less than ten seconds. All areas where soap bubbles appear shall be marked and repaired as described in this section.

Air Pressure Testing (for fusion wedge welded seams): The equipment shall consist of the following: an air pump (manual or motor driven) equipped with pressure gauge capable of generating and sustaining pressures over 35 psi and mounted on a cushion to protect the geomembrane, a rubber hose with fittings and connections, a sharp hollow needle, or other approved pressure feed device, and a pressure gauge.

Testing Shall Conform to the Following Procedure: seal both ends of the seam to be tested. Insert needle or other approved pressure-feed device into the channel created by the double-wedge weld. Energize the air pump to a minimum of 25 psi but no greater than 30 psi, close the valve and sustain the pressure for at least five minutes. If pressure loss exceeds 3 psi or does not stabilize, locate faulty area and repair as described in this section. Puncture opposite end of the seam to release air. If blockage is present, locate and test seam on both sides of blockage. Remove needle or other approved pressure-feed device and seal penetration holes by extrusion welding as necessary.

Spark Testing: The spark test method consists of introducing 24 gauge copper wire placed at the edge or just under the top sheet overlap of the two sheets, prior to the welding with the extruder. After welding, a spark detector, operating at 20,000 volts, is run along the weld. If any pinholes are present, a circuit will be completed through the copper wire and the spark detector. This will sound an alarm in the detector alerting the operator the presence of a defective area. The spark test is typically used for extrusion welded seams where there is no hazard anticipated from a spark and where there is no chance of creating a vacuum seal.

The spark detector should not be used in the presence of water or excessive moisture. There is no immediate danger to human or animal life if a circuit is made through the spark detector.

Destructive Seam Strength Testing: Destructive testing shall not be permitted.

Joints to Structures: The HDPE membrane shall be sealed to all concrete structures and other openings through the lining with an approved adhesive and in accordance with details shown on the plans and approved shop drawings.

Factory and field fabricated pipe boots shall be used to seal all pipes penetrating the liner. All joints shall be tightly bonded.

Defects and Repairs: The geomembrane shall be examined for defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter. The geomembrane surface shall be clean at the time of examination. Each suspect location shall be repaired and non-destructively tested.

Damaged geomembrane shall be removed and replaced with the same membrane type if damage cannot be satisfactorily repaired. Any portion of the geomembrane exhibiting a flaw or failing a non-destructive test shall be repaired. Procedures available include:

- Patching used to repair large holes (over 3/8" diameter) and tears (over 2" long), and contamination by foreign matter
- Abrading and re-welding: used to repair small seam sections (less than 12" long)
- Spot welding: used to repair small tears (less than 2" long), pinholes, or other minor localized flaws
- Capping used to repair large lengths of failed seams
- Removing the unsatisfactory material or seam and replacing with new material.

Patches or caps shall extend at least 6" beyond the edge of the defect, and all corners of material to be patched shall be rounded to a radius of at least 3".

Repairs shall be non-destructively tested using methods specified in this section.

Preparation of Concrete Surfaces: Concrete surfaces which are to be lined shall have all rough edges and projections removed in the area of the lining. All cracks in the concrete shall be cleaned and filled with a sand-cement mortar or approved system prior to application. Extruded expansion joint material and joint sealers shall be cut off flush. The entire surface to be lined shall be cleaned of all foreign materials and swept thoroughly.

Ballast: Place load ballast on the geomembrane, which will not damage liner to prevent wind uplift. Placement method shall be under the strict recommendation of the liner manufacturer. Ballast shall consist of HDPE "sand tubes" as shown on the design drawings.

FIELD OUALITY CONTROL:

Surveillance will be performed by the Contractor's Representative to verify compliance of the work to the drawings and specifications.

END OF SECTION 02598

SECTION 03300--CAST IN PLACE CONCRETE

PART 1--GENERAL

SUMMARY:

Section Includes: Work includes, but is not limited to:

Concrete work for concrete ditches, headwalls, endwalls, slabs, ductbanks, and other miscellaneous concrete.

REFERENCES:

The following documents, including others referenced therein, form part of this Section to the extent designated herein. The ASTM specifications referred to herein are a part of ACI 301.

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 301	Specifications for Structural Concrete for Buildings
ACI 318	Building Code Requirements for Reinforced Concrete

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 185	Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
ASTM A 615	Standard Specification for Deformed and Plain Billet-Steel Bar for Concrete Reinforcement
ASTM C 33	Standard Specification for Concrete Aggregates
ASTM C 150	Standard Specification for Portland Cement
ASTM C 260	Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C 309	Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 494	Standard Specification for Chemical Admixtures for Concrete
ASTM C 618	Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete

SUBMITTALS:

Submittals include, but are not limited to the following:

Mix Design: Submit mix design for each grade of concrete used.

Batch Tickets: Batch tickets shall be provided to the Construction Management Point of Contact (POC) for each truckload of concrete at the time of delivery.

See Section 01300, Submittals and the Vendor Data Schedule for additional submittal requirements.

QUALITY CONTROL:

Comply with provisions of ACI 301 unless otherwise specified herein.

PART 2--PRODUCTS

FORM MATERIALS:

Forms for Concrete: Furnish in largest practicable sizes to minimize number of joints. Comply with applicable provisions of ACI 301.

Form Coatings: Provide commercial formulation form-coating compounds that will not bond with, stain nor adversely affect concrete surfaces, and will not impair subsequent treatments of concrete surfaces.

Forming of Duct Banks: Forming of duct banks is not required if vertical excavation slopes can be maintained. In addition, clearances for reinforcing steel and OSHA excavation requirements must be maintained and work done in a workman like manner.

REINFORCING MATERIALS:

Reinforcing;Bars: ASTM A 615, Grade 60, deformed, as indicated on the drawings.

Supports for Reinforcement: Provide supports for reinforcement including bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcing in place. Pumice blocks, adobe, bricks, rocks, etc. are not acceptable for rebar supports.

CONCRETE MATERIALS:

Portland Cement: Cement shall conform to ASTM C 150, Type I-II. The cement shall contain no more than 0.60% by weight of alkalies calculated as ($Na_2O + 0.658\ K_2O$).

Pozzolans: Pozzolans (fly ash) shall conform to ASTM C 618 Class F, except that the loss on ignition (LOI) shall be less than 2%.

Aggregate: Fine and coarse aggregate shall conform to ASTM C 33.

Mixing Water: Potable having no pronounced taste or odor, and containing no deleterious materials.

Air-Entraining Agents (AEA): ASTM C 260.

Water-Reducing Admixtures: If water-reducing admixtures are used they shall conform to ASTM C 494, Type A, and contain no more than 1% chloride ions.

Calcium Chloride: Calcium chloride is not permitted.

RELATED MATERIALS:

Curing Compound: Curing compound or curing-hardener-sealer compound shall comply with ASTM C 309, Type I, Class **A.**

Red Coloring for Electrical Duct Encasement: Commercial grade red iron oxide, 3 lb per sack of cement.

Non-shrink Grout: Provide one of the following or approved equal:

"Masterflow 713"; Master Builders
"Sorrogrout"; Sonneborn Building Products
"Fire Star Grout"' U. **S.** Grout Co.

Joint Sealing Compound: Provide a polyurethane joint sealant material.

Expansion Joint Material: Provide ½ in. asphalt impregnated fibrous expansion material.

PROPORTIONING AND DESIGN OF MLXES:

Mix Design: Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 318.

Design mixes to provide normal weight concrete with the following specified 28-day compressive strengths, minimum, as indicated on drawings and schedules:

Class 40: 4000 psi (structural concrete for conduit encasement~~, slabs, equipment~~ @)

Class 45: 4500 psi (structural concrete for slabs, equipment pads, ditches, headwalls, and endwalls)

See ACI 301, Chapter 17 for acceptance criteria.

The concrete mix shall contain a pozzolan (fly ash) [unless otherwise approved by the Contractor's Representative].

Concrete in hard-to-place locations may utilize a high-range water reducer. No other water-reducer shall be used with a high-range water-reducer.

Red concrete is required for all electrical duct banks.

Durability: Concrete which will be subject to freezing and thawing, weathering, ***and*** deicer chemicals shall be air-entrained, and shall have a minimum 28-day compressive strength of 4,500 psi and a maximum water-cement ratio of 0.45. Add air-entraining agent (AEA) at the manufacturer's prescribed rate to result in concrete at point of placement having air content complying with ACI 301.

MIXING AND DELIVERY:

The manufacture and delivery of all concrete shall conform to ACI 301. Hand-mixed concrete is prohibited.

Concrete which is rejected for failure to meet any of the above requirements will be evaluated by the Contractor and may be removed and replaced at the expense of the Subcontractor.

SOURCE QUALITY CONTROL:

The Subcontractor shall provide the necessary testing and monitoring to qualify proposed materials and establish mix designs.

PART 3--EXECUTION

FORMS:

Comply with ACI 301.

PLACING REINFORCEMENT:

Comply with ACI 301.

Unless otherwise shown on the drawings, splicing of reinforcement shall be in accordance with ACI 318, Chapters 7 and 12. Unless otherwise indicated on the drawings, all splices shall be Class B tension splices for regular bars.

JOINTS:

Construction Joints: Locate and install construction joints, when not shown on drawings, so as not to impair strength and appearance of the structure, and as acceptable to the Contractor's Representative.

Joint Sealing Compound: Provide a polyurethane joint sealant compound.

CONCRETE PLACEMENT:

Comply with ACI 301.

FINISH OF FORMED SURFACES:

Rough Form Finish (RfFm): Provide as-cast rough form finish to formed concrete surfaces that are to be concealed in finish work or by other construction, unless otherwise indicated.

Standard rough form finish shall be the concrete surface having the texture imparted by the form facing material used, with tie holes and defective areas repaired and patched and all fins and other projections exceeding 1/4 in. in height rubbed down or chipped off.

Smooth Form Finish (SmFm): Provide as-cast smooth form finish for formed concrete surfaces that are exposed-to-view, or that are covered with a coating material applied directly to concrete, or a covering material bonded to concrete such as waterproofing, dampproofing, painting, or other similar system.

Produce smooth form finish (SmFm) by selecting form material to impart a smooth, hard, uniform texture and arranging them orderly and symmetrically with a minimum of seams. Repair and patch defective areas with fins or other projections completely removed and smoothed.

Related Unformed Surfaces: At tops of headwalls, endwalls, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces, strike off smooth and finish with texture matching adjacent formed surfaces.

Equipment Bases and Foundations: Provide equipment bases and foundations, as shown on drawings. Set anchor bolts for electrical panels and equipment to template at correct elevations, complying with certified diagrams or templates of manufacturer furnished machines and equipment.

CONCRETE DITCH FINISH:

Float Finish (Flt): Apply float finish to concrete ditch surfaces to receive trowel finish and other finishes as hereinafter specified.

After screeding, consolidating, and leveling concrete ditches, do not work surface until ready for floating. Begin floating when surface water has disappeared or when concrete has stiffened sufficiently, or both. Consolidate surface with power driven floats, or by hand floating if area inaccessible to power units. Check and level surface plane to a tolerance not exceeding 1/4 in. in 10 ft when tested with a 10-ft straightedge placed on surface at not less than two different angles. Cut down high spots and fill low spots. Uniformly slope surfaces to drain. Immediately after leveling, refloat surface to uniform, smooth, granular texture.

Non-slip Broom Finish (Brm): Following floating, apply non-slip broom finish to concrete ditch surfaces. Brooms shall be soft-bristled to produce a fine texture and specially made for texturing concrete. Slightly roughen concrete surface by brooming in direction of the slope.

Trowel Finish (Trw): Apply trowel finish to monolithic slab surfaces to be exposed to view, unless otherwise indicated.

CONCRETE CURING AND PROTECTION:

General: Protect freshly placed concrete from injurious action by sun, rain, wind, flowing water, mechanical injury and premature drying for not less than seven **(7)** consecutive days after placement.

Protect concrete against damage from frost or freezing for a minimum of 3 days. Provisions of ACI 306.1 shall apply for cold weather unless otherwise specified.

Alternatively, if tests are made of cylinders kept near the structure and cured by the same methods, moisture retention measures may end when the average compression strength has reached 70% of the specified strength. Other alternatives such as those given in ACI 301, 5.3.6 may also be used if approved by the Contractor.

Curing Methods: Perform curing of concrete by one or more of the following methods:

Moist Curing: Cover concrete surfaces with moisture retaining cover for curing period. Exposed horizontal concrete surfaces may be covered with sand or other approved material and kept wet for the required period. Wood forms shall be kept sufficiently wet at all times to prevent the forms from separating at the joints and the concrete from drying.

Membrane Curing: Concrete surfaces to receive membrane curing shall be treated with a curing compound as specified or otherwise approved. The curing compound shall be applied in strict accordance with the directions of the manufacturer of the compound.

Temperature, Wind, and Humidity:

Cold Weather: When the mean daily outdoor temperature is less than 40^{o} F, the temperature of the concrete surface shall be maintained between 55 and 90" F for the required curing period. When necessary, arrangements for heating, covering, insulating, or housing the concrete work shall be made in advance of placement and shall be adequate to maintain the required temperature without injury due to concentration of heat. Combustion heaters shall not be used during the first 24 hrs unless precautions are taken to prevent exposure of the concrete to exhaust gases that contain carbon dioxide. If early loading is anticipated during cold weather, provide temperature protection to insure necessary strength development.

The concrete surface temperature requirements (based on section thickness) in ACI 306.1 may be used in lieu of the 55" F minimum specified before.

If concrete surface temperatures as measured by the inspecting agency are below the minimum curing temperature but meet the freeze protection requirements, the concrete curing period shall be extended to ensure adequate strength is developed. The extension time shall be at least equivalent to the time period in which temperatures were too low.

Hot Weather: The concrete surfaces shall be kept below 100° F for the curing period. When necessary, provision for windbreaks, shading, fog spraying, sprinkling, ponding, or wet covering with a light colored material shall be made in advance of placement, and such protective measures shall be taken as quickly as concrete hardening and finishing operations will allow.

Rate of Temperature Change: Changes in temperature of the air immediately adjacent to the concrete during and immediately following the curing period shall be kept as uniform as possible and shall not exceed 5" F in any 1-hr or 50° F in any 24-hr period.

REMOVAL OF FORMS:

Formwork Not Supporting Weight of Concrete: This formwork may be removed after cumulatively curing at not less than 50° F for 32 hrs after placing concrete, provided concrete is sufficiently hard not to be damaged by form removal or subsequent operations. Curing must then continue through the minimum curing period.

CONCRETE SURFACE REPAIRS:

Comply with ACI 301.

FIELD OUALITY CONTROL:

Subcontractor Supplied Testing: The Subcontractor shall provide the necessary testing and monitoring services for the following:

Testing services needed by the Subcontractor to control or monitor the production, transportation, placement, protection, curing or temperature of the concrete

The use of Contractor supplied inspection or testing services shall in no way relieve the Subcontractor of the responsibility to furnish materials and construction in full compliance with the subcontract documents.

Contractor Supplied Testing: The Contractor's Representative will perform tests during placement and curing of the concrete. Monitoring of concrete protection and curing methods may also occur. Sampling and testing for quality control during placement of concrete may include any of the tests specified in ACI 301 16.3.

1 END OF SECTION 03300

SECTION 15401--PIPING AND PUMPING SYSTEM

PART 1--GENERAL

SUMMARY:

The Subcontractor shall furnish, install, and test all equipment, materials and supplies and perform all work and operations necessary for furnishing and installing the piping, fittings, valves, and equipment as shown on the subcontract drawings and specified herein. Upon completing installation, the Subcontractor shall operate and test as specified hereinafter to verify that the systems are properly installed and operate as required.

Section Includes: Work includes, but is not limited to:

Furnish, install, and testing all piping, fittings, valves, and equipment as required to complete the work included in this specification section and as shown on the subcontract drawings

Furnish and install 1 submersible sump pump, pump controller and totalizer; and all associated piping, conduit, wiring and ultrasonic level switches.

REFERENCES:

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 1248	Standard Specification for Polyethylene Plastics Molding and Extrusion Materials
ASTM D 3350	Polyethylene Plastic Pipe and Fittings Materials

INTERNATIONAL PLUMBING CODE

IPC	International Plumbing Code

SUBMITTALS:

~~Butt fusion procedure.~~

~~Butt fusion personnel qualifications.~~

Operation and Maintenance Manuals for Flow Totalizer.

Operation and Maintenance Manuals for Pump.

Calibration Data for Flow Totalizer.

See the Vendor Data Schedule for additional submittal requirements.

OUALITY CONTROL:

Qualifications: System shall be furnished and installed by a firm qualified, accredited and regularly engaged in this type of work, and shall maintain shop and facilities for fabrication and maintenance of subject equipment.

Items of Any One Classification: Items which are used in quantity, such as valves, specialties, accessories, fittings, etc., shall in each case be the product of one manufacturer, and shall be used only for the services recommended by the manufacturer.

Materials, Products and Equipment: Materials, products and equipment shall be first quality and be furnished and installed in strict accordance with the subcontract drawings and these specifications.

Experience: The pump manufacturer shall have a minimum of 200 units of similar type pumps, installed and operating for no less than five *(5)* years in the United States.

Construction Component (CC) Test: The sump pump shall be CC tested for basic operation prior to installation per Section 15600 of these specifications.

Performance Test: The pump and system shall be performance tested per Section 15600 of these specifications.

MATERLAL DELIVERY, STORAGE AND HANDLING:

Delivery: Subcontractor shall ensure that all materials are delivered in a new, undamaged and protected condition.

Receiving Inspection: Each shipment shall be inspected by the Subcontractor prior to acceptance. If damage is found or any material, identification, and/or documentation is missing, this fact shall be promptly reported to the delivering carrier(s), the manufacturer and the Contractor's Representative.

Storage and Handling: Materials shall be resealed and repacked after inspection, and shall be stored in its original protective packing, or its equivalent. The Subcontractor shall ensure that materials are stored in a manner to provide protection against damage, atmospheric corrosion and contamination.

PART 2--PRODUCTS

PVC Piping: Piping shall be schedule 40 PVC bell and spigot per ASTM D-2665.

PVC Fittings: End caps and custom elbow shall be schedule 40 per ASTM D-1784.

PVC Adhesive: Adhesive shall be as recommended by the PVC manufacturer for pressure service and temperature ranges from -20° to 120° F.

High Density Polyethylene Pipe (HDPE): The pipe shall be PE 3408, high density, high extra molecular weight polyethylene piping system. The material shall be specified by ASTM D 3350 ~~and have a cell classification number of 345434C~~. Dimensions and workmanship are specified by ASTM F714. The pressure rating shall be 160 psi which is equivalent to a Standard Dimension Ratio (SDR) of 11. The ends shall be suitable for butt-fusion.

HDPE Fittings: Fittings shall be High Density Polyethylene produced by the same manufacturer as the pipe with a pressure rating of 160 psi (SDR 11) which matches the pipe rating. The ends shall be suitable for butt-fusion. Transition fittings from HDPE to THD shall be ~~by the same manufacturer as the HDPE and shall be~~ stainless steel.

Flange Adapters: Use HDPE (SDR 11) molded flange adapters with ends suitable for butt fusion.

Back-Up Rings: Use 316 stainless steel convoluted back-up rings coated with polybutylene.

Bolting: Use 316 SST ASTM A193 Gr B8 bolts and galling resistant Nitronic 60 nuts ASTM A194 Gr 8S (UNS S21800). Coat the stud bolts and nuts with coal tar epoxy.

Gaskets (HDPE Pipe): Proco Series 9013 Style EP full-face low torque gaskets suitable for 300 psi service and a service temperature range of -40° F to 300" F. Dimensions shall be per ANSI B16.5.

Vacuum Breaker: Watts 3/4 in. Model 8A brass for vertical installation (top outlet) with and threaded connection and a required opening vacuum of 6 in. water column.

Sample Valve: Sample valve shall be Apollo 1/2 in. 96-103 stainless steel ball valves with threaded connections.

Pump: The pump and electrical motor shall be a submersible, solids handling, sump pump as manufactured by ~~Ebara or approved equal~~EPG Companies Model WSD PT 2-2. Maior components including impeller(s), housing, shaft, and check valve shall be 304 stainless steel. The pump shall be equipped with a 1/2 hp submersible electric motor for operation on a 115 volts, 1 phase, 60 hertz service;;-. Motor shall be designed for continuous duty and 100 starts per day. ~~with~~ Unit shall include UL Listed cord of field determined length with 2 - #12 THWN and 1 - #12 THWN ,ground minimum approved for submersible applications. ~~The power cord shall be sized according to NEC and ICEA standards~~Cord shall not be spliced. The electric motor shall have internal overload protection with automatic reset. The pump shall be capable of delivering ~~35~~ 10 gpm at ~~25~~ 35 ft of head and passing a 3/8 in. solid. The

pump discharge ~~line~~ shall be ~~1 1/2 FPT~~1-1/4 NPT. ~~The pump shall be an Ebara model 40P707U6.6S with extra long power cord or approved equal~~

In no case shall the required horsepower at any point on the performance curve exceed the horsepower of the motor when using any of the impellers available for use with the proposed pump.

The pump controller shall use Gems ultrasonic level switches, Model #ULS-10 with the remote electronics option ~~or approved equal~~ to control the level of the water in the sump and initiate a high sump alarm.

Controls: Furnish and install one simplex, 1/2 HP, 1 phase, 115 V, Pump Control Panel in a gasketed NEMA 3R, dead front, door-in-door enclosure for mounting on framing channel. The controller shall include: 120 V circuit breaker, starter, Hand/Off/Auto switch, intrinsically safe pump controller, pump run light, and running time meter. The controller shall also have: a weatherproof 100 W high level alarm light, audible alarm with silence pushbutton, an anti-condensate heater and thermostat, a secondary lightning arrestor, a common disconnect switch with a lever through the inner door for the power breaker; and Gems ULS-10 Ultrasonic Level Switches with a remote electronics, sensors and manufacturer supplied coax cables. The Pump Control Panel shall be UL Listed.

Totalizer: The totalizer shall be capable of recording total flow and flow rates from 5 gpm minimum to 50 gpm maximum within 2% accuracy. The totalizer shall have 1 in. THD connections and shall be a direct mechanical readout. The totalizer shall be a SeaMetrics M-Series MT-1.

PART 3--EXECUTION

INSTALLATION OF ALL SYSTEMS:

Joints: Butt fusion shall be accomplished per manufacturer's written instructions. Refer to INEEL Weld Manual Section **2** (19.0 Bonding of Non-metallic Components).

PVC joints shall be made in strict accordance with the adhesive manufacturers written instructions.

Pipelines: Pipelines shall be installed per the drawings in neat and orderly manner. Installation shall avoid interference with work of the other trades.

Pipes shall be full lengths to greatest extent possible. Piping shall be cleaned of dirt, rust, scale, grease and other foreign matter. Piping shall be kept clean as work progresses.

Line flushing will occur with pump performance testing included in Section 15600.

Pump: The sump pump and accessories shall be installed in accordance with the manufacturer's recommendations

Controls: The installation of the controls system shall be performed and tested by a Manufacturer's Representative under the supervision and at the expense of the Subcontractor.

VALVE TAGS:

After installation, all valves shall be identified by tagging with their number or designation as shown on the drawings. The tag shall be fabricated from 24 gage, 3/4 in. wide, 3 in. long, AISI Type 303 or 304 stainless steel metal strip with 3/16 in. high letters stamped in the metal surface. The tags shall be tied to the line with AISI Type 304 annealed stainless steel bead chain with stainless steel catches. All tags must be free from sharp edges.

FIELD OUALITY CONTROL:

Subcontractor Supplied Testing: All testing shall be done in accordance with Section 15600.

Contractor Inspection: Surveillance will be performed by Contractor's Representative to verify compliance of the work to the drawings and specifications.

END OF SECTION 15401

SECTION 15600--TESTING PIPING AND PUMP

PART 1--GENERAL

SUMMARY:

Section Includes: Work includes, but is not limited to:

Pressure testing all new piping

Functional testing of the Electric.

SUBMITTALS:

Hydrostatic Pressure Testing Procedure/Report for HDPE pipe.

CC Testing Test Procedure/Report for pump.

~~Performance Testing Procedure/Report for pump system.~~

See the Vendor Data Schedule.

PART 2--PRODUCTS

MATERIAL:

The Subcontractor shall furnish all materials, instruments, and equipment required to perform the hydrostatic pressure test of the HDPE pipe and functional testing of the pump. All test equipment shall have been calibrated within 60 days of use, be in good working order and have gauges accurate to within $\pm$ 3.0% of span.

PART 3--EXECUTION

PIPE TESTING AND PERFORMANCE TESTING

Hydraulic Testing of HDPE Pipe: The HDPE piping system shall be pressure tested after complete installation. The piping may be tested in two phases to facilitate construction: (1) piping from the pump through the totalizer, and (2) piping downstream of the totalizer.

Hydrostatic test pressure for the HDPE piping system shall be 50 psi.

The Subcontractor shall submit a written hydrostatic pressure testing procedure to be approved by the Contractor prior to beginning a test. The procedure shall include a test record to be completed after the test. See Test Records Section of this specification.

After all free air is removed from the test section, raise the pressure at a steady rate to the required pressure. The pressure in the section shall be measured at the mounting rack.

Initially, the pipe should be raised to test pressure and allowed to stand without makeup pressure for a sufficient time to allow for expansion of the pipe. This usually occurs within 2-3 hours. After equilibrium is established, the test section shall be pressurized to 50 psi, system isolated, and the final test pressure is held for 1 hour.

The system is acceptable if there are no visible leaks or pressure drops in excess of 2 psi during the test period.

After satisfactory completion of a test, all temporary blinds are to be removed. Valves, short pieces of piping and any other items removed for the test are to be reinstalled with proper gasketing.

Caution: Changes in temperature will increase or decrease the apparent test pressure in any piping system. When the HDPE piping system becomes heated (e.g. on a summer day), the system pressure will decrease. When the HDPE piping system becomes cooler, the system pressure will increase. Testing shall be done during periods of relatively stable atmospheric temperatures.

Under no circumstances shall the total time under the test exceed eight (8) hours at the pressure rating. If the test is not completed due to leakage or equipment failure, the test section shall be allowed to "relax" for eight **(8)** hours prior to the next test.

CC Test of Pump: The Subcontractor shall submit a test plan for review and approval. The purpose of the test is to verify pump operation prior to installation.

~~Performance Test of the Pump System: The Subcontractor shall submit a test plan for review and approval. On-site testing shall be performed after installation of the piping system and prior to burial. The purpose of the test is to verify system operation in the installed configuration. It is anticipated that the Subcontractor shall add water to the sump to perform the test. Water shall be discharged to an area directed by the Contractor's Representative.~~

~~The Test Plan shall define methodology, equipment, sequence and safety precautions; and document all actions required to perform the test.~~

~~The test plan shall be reviewed and approved by the Contractor. This process includes reviewing, commenting, and accepting comment resolution.~~

~~The Test Report summarizes the activities performed in accordance with the test procedure, anomaly and noncompliance resolution, and contains an as-run copy of the test procedure.~~

TEST RECORDS:

Accurate test records shall be kept. Each test shall be witnessed and approved by the Contractor's Representative. The Contractor's Representative shall be notified forty-eight (48) hours prior to beginning a test.

Hydraulic Test Report Shall Include:

Hydrostatic Test pressure and pressure steps

Leaks, repairs, retest pressure

Date and Contractor's approval results

Contractor's Representative approval space

Repairs and retests

Calibration dates of testing and equipment.

CC Test Report Shall Include:

Verification and results of pump operation.

~~Pump Performance Test Report Shall Include:~~

~~Pump Start and Stop times to establish run duration and associated readings on the flow totalizer to establish system flow rates~~

~~Anomalies in system operation.~~

FIELD OUALITY CONTROL:

Contractor Inspections: Surveillance will be performed by the Contractor's Representative to verify compliance of the work to the drawings and specifications.

END OF SECTION 15600

SECTION 16000--ELECTRICAL GENERAL PROVISIONS

PART 1--GENERAL

SUMMARY:

The Subcontractor shall provide, install, terminate, and test all the systems as described in the specification and shown on the drawings to make complete and operational systems including but not limited to:

Installing a sump pump control panel, disconnect switch and instrumentation as indicated on the drawings

Installing the associated conduit, junction boxes, wiring and grounding

Modification of an existing 15 kV duct bank and the installation of 15 kV feeder cable.

RELATED SECTIONS:

02200 Earthwork (duct bank installation)
03300 Cast-In-Place Concrete
15401 Piping and Pumping System

REFERENCES:

The following documents, including others referenced therein, form part of all 16000 series sections to the extent designated. Unless otherwise indicated, use the latest edition in effect as of the date of these specifications.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

NESC National Electrical Safety Code

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA-70 National Electrical Code (NEC)

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1910 Subpart **S** OSHA Electrical Safety

FACTORY MUTUAL (FM)

NATIONAL RECOGNIZED TESTING LABORATORIES (NRTL)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

UNDERWRITERS' LABORATORIES, INC. (UL)

UL 486A	Wire Connectors and Soldering Lugs for Use with Copper Conductors.

Underwriters Laboratories (UL): All materials, appliances, equipment or devices shall conform to the applicable standards of Underwriters Laboratories, Inc. All material, appliances, equipment or devices shall be listed and/or labeled by UL.

SUBMITTALS:

Test Reports and Procedures: Submit test procedures and reports for a construction component test (CC) of all equipment for controls and devices installed or modified by the Subcontractor. Prior to testing all procedures shall be submitted for Contractor approval.

See Section 01300, Submittals and Vendor Data Schedule for additional submittal requirements.

PART 2--PRODUCTS

Furnish all labor, materials, equipment and appliances required to complete the installation of the complete electrical systems. The completed electrical system shall conform to applicable provisions of the specifications and the subcontract drawings.

All labor, materials, service, equipment, and workmanship shall conform to the applicable referenced standards and regulations.

MANUFACTURERS:

Where multiple units of a product are required, provide identical products by the same manufacturer without variations except for sizes and similar variations as indicated.

MATERIALS:

Except as otherwise indicated, furnish new electrical products, free of defects and harmful deterioration at the time of installation. Provide each product complete with trim, accessories, finish, guards, safety devices and similar components specified or recognized as integral parts of the product, or required by governing regulations.

Unless otherwise indicated by the drawings or specifications or approved in writing, the materials and/or equipment furnished under these specifications shall be the standard products of manufacturers regularly engaged in the production of such equipment, and shall be the manufacturer's standard design.

Environmental Conditions:

All installations and equipment shall be required to operate normally under the following climatic and geographic site conditions

Site Elevation	.4,917 feet
Barometric Pressure	12.27 psia
Relative Humidity	90% max. at 30" F dry bulb
	15% min. at 60" F *dry* bulb
Uniform Building Code	Seismic Zone 2B
Temperature	+40" C max.
	-40" C min.

NEMA 3R enclosures will be provided for all outdoor equipment and NEMA 1 for all indoor equipment unless noted otherwise on drawings.

Labeling: See Section 16195--Electrical Identification for labeling requirements.

PART 3--EXECUTION

SEQUENCING/SCHEDULING:

General: It is recognized that the subcontract documents are diagrammatic in showing certain physical relationships which must be established within the electrical work and in its interface with other work, including utilities and mechanical work, and that such establishment is the exclusive responsibility of the Subcontractor. Subcontractor shall arrange electrical work in a neat, well-organized manner with conduit and similar services running parallel with the primary lines of the building construction.

Subcontractor shall locate operating and control equipment properly to provide easy access, and working clearance in accordance with the NEC. Subcontractor shall advise other trades of openings or clearances required in their work for the subsequent move-in and assembly of large units of electrical equipment.

OUALITY CONTROL:

Subcontractor Supplied Testing: Upon completing installation of all systems and equipment, but prior to project close out, the Subcontractor shall conduct a construction component test (CC) of all equipment for controls and devices installed or modified by

the Subcontractor. **As** a minimum, all of the manufacturers' recommended pre-startup tests and measurements shall be performed as well as other CC tests required by these specifications. Prior to testing all procedures shall be submitted for Contractor approval.

All equipment shall test satisfactory or be repaired or replaced at no additional cost to the Contractor.

As part of the Construction Component (CC) Tests, all electrical connections and mounting fasteners shall be tightened to torque specifications stated by the equipment manufacturer. If manufacturer has no recommended torque value tighten as per UL 486A.

The Subcontractor shall test all devices in the presence of the Contractor's Representative. Subcontractor shall coordinate testing with the Contractor.

Contractor Inspection: Surveillance will be performed by the Contractor's Representative to verify compliance of the work to the drawings and specifications.

END OF SECTION 16000

SECTION 16109--SWITCHES, RECEPTACLES AND WALL PLATES

PART 1--GENERAL

SUMMARY:

Subcontractor shall provide and install switches and receptacles of sizes, ratings, materials and types as shown on the drawings.

Section Includes, but is not limited to:

Installation of new devices as detailed on the drawings.

Related Sections:

16000 Electrical General Provisions

REFERENCES:

See the list of general references in Section 16000.

SUBMITTALS:

Submittals include, but are not limited to the following:

Receptacle test results.

See Section 01300, Submittals, other electrical sections for additional submittal requirements.

PART 2--PRODUCTS

MATERIALS:

Receptacles:

Heavy-Duty Duplex: Provide specification grade, duplex heavy-duty, flush or surface mounted receptacles, 2-pole, 3-wire grounding, with green hexagonal equipment ground screw, ground terminals and poles internally connected to mounting yoke, 20 ampere, 125 V, with metal plaster ears, side wiring, NEMA Configuration 5-20R unless otherwise indicated on the drawings. Duplex receptacles shall be Hubbell HBL 53621.

Wall Plates:

Material and Finish/Outdoor Use: Receptacle covers installed outdoors shall be rain tight with a NEMA 3R rating. They shall maintain this rating when equipment is plugged in. This shall be accomplished by using flip lids or similar. Cover shall close automatically when released. All components of receptacle cover shall be made of corrosion resistant materials. Weatherproof cover shall be a Hubbell WP826MP.

PART 3--EXECUTION

INSTALLATION:

Install receptacles, switches and wall plates where indicated on the drawings in accordance with recognized industry installation practices.

Receptacles to be mounted as shown on the drawings.

Coordinate with other work including electrical raceway and equipment installation work, as necessary to interface installation of wiring and devices with other work.

Install receptacle only in electrical boxes which are clean and free from building materials and debris.

LABELING:

Label all covers and plates. Install labels per Section 16195--Electrical Identification.

FIELD OUALITY CONTROL:

Subcontractor Supplied Inspection and Tests: The Subcontractor or his agents shall perform the following:

1. Visual inspection to determine that equipment installation conforms to NEC, these specifications and the drawings
2. Subsequent to hooking-up cables/wires and devices, energize circuitry and demonstrate functioning in accordance with requirements
3. Each receptacle shall be tested with a portable receptacle circuit tester to test for polarity, grounds, and opens.

Subcontractor shall furnish a data sheet, listing area and number of receptacle tested and test results.

Circuit testers shall be approved by the Contractor's Representative prior to use.

Contractor Inspection: Surveillance will be performed by the Contractor's Representative to verify compliance of the work to the drawings and specifications.

END OF SECTION 16109

SECTION 16110--ELECTRICAL RACEWAYS

PART 1--GENERAL

SUMMARY:

Section Includes: Work includes, but is not limited to:

Subcontractor shall provide and install electrical raceways of types, grades, and sizes as shown on the drawings. Provide complete assembly of raceway including, but not necessarily limited to, couplings, elbows, adapters, hold-down straps, and other components and accessories as needed for a complete system.

Coordinate with other work as necessary to interface installation of electrical raceways and components with other work.

RELATED SECTIONS:

02200 Earthwork
03300 Cast-In-Place Concrete
15401 Piping and Pumping Systems
16000 Electrical General Provisions
16195 Electrical Identification

REFERENCES:

The following documents, including others referenced therein, form part of this specification section to the extent designated. Unless otherwise indicated, use the latest edition in effect as of the date of these specifications. See the list of general references in Section 16000.

SUBMITTALS:

No vendor data required for this section.

PART 2--PRODUCTS

MATERIALS:

Conduit and Fittings: Rigid Galvanized Steel (RGS) conduit or Intermediate Metal Conduit (IMC) shall be used for all conductors unless noted otherwise on the drawings. All conduits shall be UL approved, 3/4-in. minimum unless shown otherwise on the drawings.

Polyvinyl chloride (PVC) conduit that is encased in concrete shall be type EB (Encased Burial). All underground bends of 30 degrees or more shall be rigid galvanized steel conduit.

Liquid-tight, flexible conduit shall be installed in wet locations. Liquid-tight flex shall be grounding-type with a PVC jacket.

Conduit fittings for rigid conduit (RGS or IMC) shall be rust-resistant cast steel.

Junction Boxes: Junction boxes in the 12 in. PVC sump pump pipe shall be weatherproof rust-resistant cast steel. Other junction boxes shall be galvanized.

Locator Ribbon: Locator ribbon shall be installed approximately 6 in. above buried conduit and ductbanks. See Section 02200 for buried pipe identification ribbon requirements.

Framing Channel for Conduit/Box Support: Where indicated on the drawings or as required by the NEC, bolted fi-aming channel shall be used to support conduits and electrical boxes. Galvanized Steel channel shall be used in all outdoor/exterior locations and epoxy painted channel in all interior locations. The minimum size bolt used for bolt framing channel together for a support structure shall be 3/8". The exposed ends of all framing channels shall have a protective cap installed. Sizes shall be as detailed on the drawings. All framing channels shall be made of channel, fittings, and hardware as defined in MFMA-1 and shall be minimum 14-gauge steel. Framing channel shall be as manufactured B-Line Systems or approved equal.

PART 3--EXECUTION

INSTALLATION:

Install conduit, tubing and duct products as indicated on the drawings in accordance with manufacturer's written instructions, applicable requirements of NEC and National Electrical Contractors Association's "Standard of Installation," and complying with recognized industry practices to ensure that products serve intended functions.

All conduit joints shall be cut square, threaded, reamed smooth, and drawn up wrench tight. Bends or offsets shall be made with standard conduit bending dies that will not injure or flatten the pipe.

Rigid conduit terminating at cabinets and boxes shall be rigidly secured with locknuts inside and outside.

Male threads on exterior runs of galvanized steel conduits shall be thoroughly coated with a conducting sealing media such as petroleum base products. No red lead shall be used on any conduit joint.

All conduit penetrations shall be sealed around outside of conduits with sealant appropriate for building material (i.e., grout for concrete walls, fire stop caulk for drywall, etc.).

CONDUIT IDENTIFICATION:

Label conduits per Section 16195--Electrical Identification.

UNDERGROUND DUCTS:

All underground ducts shall be installed in locations shown on drawings, enclosed in a red concrete casing. The concrete casing shall also enclose all standard conduit bends or elbows. All underground ducts shall have rebar reinforcement in sizes as shown on the drawings.

Excavate the trenches to provide elevation on top of concrete envelope as shown on drawings. After trenches are excavated and graded, the duct shall be laid in rows on plastic spacers.

Spacers shall be so placed that each section of duct is supported at intervals as specified in NFPA 70 (NEC). Concrete shall then be poured until the ducts are covered to the required depth and leveled leaving not less than 3 in. of concrete over top tier of ducts. All concrete work shall be performed per Section 03300--Cast in Place Concrete.

All trench work shall be back-filled and compacted per Section 02200--Earthwork.

FIELD QUALITY CONTROL TESTING:

Site Tests: The Subcontractor or his agents shall perform visual inspections to determine that equipment installation conforms to the NEC, these specifications, and the drawings.

Contractor Inspection: Surveillance will be performed by the Contractor's Representative to verify compliance of the work with the drawings and specifications.

END OF SECTION 16110

SECTION 16120--CABLE, WIRE, CONNECTORS AND MISCELLANEOUS DEVICES

PART 1--GENERAL

SUMMARY: The Subcontractor shall furnish, install, and terminate all cables conductors, and devices to make complete and operational systems.

Section Includes: Work includes, but is not limited to wiring for:

Power and control systems

Subcontractor shall provide, install, and terminate cables, cords, and wiring connectors of sizes, ratings, materials and types as shown on the drawings or described in related sections.

Related Sections: See other related sections for specific cables, wire, labels, and testing requirements.

16000 Electrical General Provisions
16l 10 Electrical Raceways
16195 Electrical Identifications

REFERENCES:

The following documents, including others referenced therein, form part of this specification section to the extent designated. Unless otherwise indicated, use the latest edition in effect as of the date of these specifications.

NATIONAL ELECTRICAL CABLE ASSOCIATION (NECA)

Standard for Installation Practices

UNDERWRITERS LABORATORIES, INC. (UL)

UL 1581 Electrical Wires, Cables, and Flexible Cords

SUBMITTALS:

Test Reports: Submit test reports for end to end continuity tests and megger tests of all 480 V wiring and all cables or wires No. **8** and larger prior to terminating.

See Section 01300, Submittals and Vendor Data Schedule for additional submittal requirements.

PART 2--PRODUCTS

WIRING MATERIALS, 600 V:

Conductors shall be stranded for all sizes of wire and cable larger than 12 AWG.

Conductors shall be copper for all sizes.

Wire insulation shall be Type THHN/THWN or XHHW for all 600 V conductors unless otherwise noted. Minimum size of power conductors shall be No. 12.

Wiring shall be color-coded as indicated below:

	Conductor Color Code		
Conductor	208/120 Volts"	4801277 Volts*	240/120 Volts*
Phase A	Black	Yellow	Black
Phase B	Red	Orange	Red
Phase C	Blue	Brown	
Neutral	White	Gray	White
Ground	Green	Green	Green

* For conductors larger than #10 AWG not generally furnished with colored insulation, identification shall be achieved by the use of plastic tape or sleeves of the appropriate color. Yellow phase tape shall consist of two separate bands at each application point in order to avoid confusion with white, gray, or orange after aging. All wire markers and phase tape shall be covered by clear heat shrink sleeving.

Wire #10 AWG and smaller shall be furnished with continuous colored insulation for all power, neutral and ground conductors when multiple circuits are installed to identify the phase connected to, neutral, or equipment ground wiring. Bare copper conductors shall only be used for ground conductors as shown on the drawings.

SPLICES:

Splices for underground (grounding and power (600 V)) cabling shall be UL listed and labeled and be of the material type and design appropriate for the conductors and application involved. Scotchcast splice kits shall be used for cathodic protection cable splices.

All splices shall be visually inspected for material type, proper installation and damage by the Contractor's Representative.

Splices shall be installed by qualified craftsmen that routinely perform this task as part of their regularly assigned duties.

CONNECTORS:

Connectors shall only be used as specified by manufacturer.

Spring type pressure connectors such as "Scotchlock," shall be used for splicing No. 8 AWG and smaller.

Splitbolt and/or lug type connectors such as "Burndy" shall be used for splicing No. 6 AWG and larger.

Scotch mastic pads and two layers of half wrapped electrical tape shall be installed over all splitbolt connectors.

Crimp on ring tongue lug connectors such as "Stakon," shall be used for connection to terminal boards.

Wire/Device Identification: See Section 16195--Electrical Identification.

WIRING MATERIALS, SIGNAL CABLES:

The ultrasonic transducer extension cable shall be RG-62/U Type Belden 82269.

PART 3--EXECUTION

INSTALLATION:

General: Install electrical cable, wire and connectors as indicated on the drawings, in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation," and in accordance with recognized industry practices to ensure products serve intended functions. All connections shall be tightened to the manufacturers published torque values. Where manufacturer does not specify torque requirement, connections shall be torqued to values specified in UL 486A.

Coordinate cable and wire installation work with electrical raceway and equipment installation work, as necessary for proper interface.

Pull conductors together where more than one is being installed in a raceway. Do not exceed the conductor manufacturers recommended pulling tension.

Use pulling compound or lubricant, where necessary; compound shall not deteriorate conductor or insulation.

Use pulling means including fish tape, cable, or rope which shall not damage raceway.

Install splices and taps which have mechanical strength and insulation rating equivalent-or-better than conductor.

Use splice and tap connectors which are compatible with conductor material.

FIELD QUALITY CONTROL:

Subcontractor Supplied Testing:

Meggering: Megger test all 480 V wiring and all cables or wires No. 8 and larger prior to terminating. Test wire or cable insulation resistance with megger (500 V megger for 300 V insulation and 1000 V megger for 600 V insulation). Any wire with less than 10 megohms to ground or other conductors shall be replaced before proceeding with the terminating. List conductors tested on Subcontractor furnished test data submittal sheet. An alternate megger test voltage can be used as recommended by the manufacturer for the specific cable or wiring. Check phase rotation of all three-phase circuits.

The Subcontractor shall perform an end to end continuity test on each conductor installed and submit test results to the Contractor for review.

Contractor Inspection: Surveillance will be performed by the Contractor's Representative to verify compliance of the work to the drawings and specifications.

The Contractors representative will witness the installation of any cables installed via approved "pull by" method.

Wires **and** cables will be checked for proper termination and termination tightness.

END OF SECTION 16120

SECTION 16124--INSULATED MEDIUM VOLTAGE CABLE AND CONNECTORS

PART 1--GENERAL

SUMMARY:

This section includes single conductor cables, cable splices, terminations and accessories for medium voltage cables.

Section Includes, but is not limited to:

Provide and install 15kV cable and connectors of the types specified herein and as shown on the drawings.

Related Sections:

16000 Electrical General Provisions
16110 Electrical Raceways
16195 Electrical Identification

REFERENCES:

The following documents, including others referenced therein, form part of this Section to the extent designated herein. Unless otherwise indicated use the latest edition in effect as of the date of these specifications.

INSTITUTE OF ELECTRICAL & ELECTRONICS ENGINEERS INC. (IEEE)

IEEE 48	IEEE Standard Test Procedures and Requirements for High-Voltage Alternating Current Cable Terminations
IEEE 386	Separable Insulated Connectors for Power Distribution Systems above 600V
IEEE 400	Guide for Making High-Direct-Voltage Tests on Power Cable Systems in the Field
IEEE 404	Standard for Power Cable Joints
IEEE 592	Standard for Exposed Semiconducting Shields on Premolded High-Voltage Cable Joints and Separable Insulated Connectors

UNDERWRITERS LABORATORIES (UL)

UL 486A	Wire Connectors and Soldering Lugs for Use with Copper Conductors
UL 1072	Medium Voltage Power Cables

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA WC8	Ethylene - Propylene Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (1CEA S-68-516)
NEMA WC26	Wire and Cable Packaging Standard

SUBMITTALS:

The Subcontractor shall provide a completed cable pull sheet to the Contractor's Representative for signature prior to cable pulling. Signed cable pull sheets or copies thereof shall be in the possession of the cable installer during each cable pulling.

15kV cable Installer qualifications.

See Section 01300, Submittals and the Vendor Data Schedule for additional submittal requirements.

QUALITY CONTROL:

Regulatory Requirements (Codes and Standards): Comply with provisions of the following codes and standards unless otherwise specified herein.

NFPA 70, National Electrical Code
National Electrical Safety Code

Cables and connectors shall each be listed and labeled by UL.

Single Source Responsibility All medium voltage cable shall be the product of a single manufacturer.

Installer Qualifications: Engage an experienced Installer of medium-voltage electrical cable to perform the installation specified in this section. In addition, for the specific work of cable splicing and terminating, engage Installers who are experienced in cable splices for the specific types of cable and cable accessories specified in this Section. Installers shall have a minimum of three years documented experience.

DELIVERY, STORAGE, **AND** HANDLING:

Deliver medium-voltage cable on factory reels conforming to NEMA WC26. Store cable reels on an elevated platform in a dry location. Cable ends shall be checked for water tight seals. Reel ends of cables shall be immediately resealed after cutting to eliminate intrusion of moisture. Cable jackets subject to ultra-violet degradation shall be stored indoors.

PART 2--PRODUCTS

MATERIALS:

MEDIUM-VOLTAGE CABLE:

General: Cable shall be single conductor type, with types and size as indicated on the drawings, and conforming to UL Standard 1072. Existing 15kV feeder cables #6008 and #6058 are Kerite shielded SPS, single conductor, #4/0 AWG. The new cable to be spliced in shall be Kerite 15kV shielded SPS, single #4/0 AWG conductor catalog #141C15-34400.

Cable Type MV-90: Cable Type MV-90 shall be EPR insulated and shall conform to NEMA Standard WC8 (1CEA S-68-516) unless otherwise shown on the drawings.

Conductors: Class B stranded, annealed copper.

Cable Jacket: Polyvinyl Chloride (PVC).

Metallic Shielding: Copper shielding tape, helically applied over semiconducting insulating shield.

Cable Voltage Ratings: 15kV phase-to-phase as shown on the drawings and in accordance with the referenced standard.

Insulation Thickness: Corresponding to 133% insulation level in accordance with the referenced standard.

Circuit Identification: Cable circuit numbers shall identify the cable at no less then every 100 ft. of exposed cable and at each entry to a ductbank system.

SPLICING AND TERMINATING PRODUCTS:

General: Comply with IEEE 48, IEEE 400, IEEE 404, IEEE 592, and UL 486A.

Types: Compatible with the cable materials.

Connectors: Compression type as recommended by cable or splicing kit manufacturer for the application.

Splicing and Terminatinn Kits: As recommended by the manufacturer in writing for the specific sizes, ratings, and configurations of cable conductor, splices, and terminations specified. Kits shall contain all components required for a complete splice or termination including detailed instructions and shall provide insulation equivalent to the insulation

class of the cable it connects. Splices shall be made with standard splicing kits and shall be of the following manufacturers: Thomas and Betts, Raychem Corp., or 3M Company.

Conductor Terminations, General: Comply with Class 1, 2, or 3 of IEEE Standard 48, as indicated. Insulation class shall be equivalent to that of the cable upon which they are installed. Terminations for shielded cables shall include a shield grounding strap. Class 2 terminations and nonshielded cable terminations shall include an effective moisture seal for the end of the insulation whether or not this item is included in terminations kits. Seal shall be cold shrink rubber sleeve, or heat shrink sleeve as recommended by the kit manufacturer. Termination kits shall be performance tested for compliance with IEEE Standard 48 and shall be of the following types:

Class 1 Termination for Outdoor Shielded Cable: Heat-shrinkable type with heat-shrinkable inner stress control and outer non-tracking tubes, multiple molded non-tracking skirt modules, and compression-type connector.

Class 1 Termination for Indoor Shield Cable: Furnished as a kit with stress relief tube, non-tracking insulator tube, shield ground strap, compression-type connector, and end seal.

Grounding Kit: Grounding kit shall include jumpered elbows, portable feed-through accessory units, protective caps, test rods suitable for concurrently grounding three-phases of feeders, and carrying case.

Conduit Seals: Conduit seals shall be designed for use with plastic, concrete or steel ducts to provide a watertight seal. It shall consist of an inflatable sealed bladder of flexible material and be self sealing. Seals shall be Raychem RDSS duct sealing.

PART 3--EXECUTION

EXAMINATION: Examine raceways, cable trays, pull boxes, manholes, junction boxes, and other cable installation locations for cleanliness of raceways, minimum bending radii of cables, and conditions affecting performance of cable installation. Pull a mandrel through raceways to check for raceway blockages and cleanliness. Do not proceed with cable installation until satisfactory conditions have been achieved.

INSTALLATION:

General: Install cable accessory items in accordance with manufacturer's written instructions and as indicated. Do not exceed manufacturer's approved maximum pulling tensions and sidewall pressure values.

INSTALLATION OF CABLES:

Install cable in accordance with manufacturers written instructions and at locations shown on the drawings. Cables installations which deviate from the drawings i.e., pull lengths or pull direction etc. shall be calculated and submitted by the Subcontractor for written approval.

Pull Conductors Simultaneously: Conductors in the same raceway shall be pulled simultaneously. Use UL-listed and manufacturer-approved pulling compound or lubricant where necessary. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values for multi conductor installation. Where only single cable maximum values are provided by the manufacturer use only 70% of the maximum tension and sidewall pressure value.

Cable Pull Sheets: Each individual cable installation shall be identified on a "Cable Pull Sheet(s)." The pull sheet shall completely identify the cable type, manufacturer's reel number, length, number and location of splices, type pulling rope, type lubricant, type cable attachment, along with a sketch of the pull.

Use Pulling; Means: Use pulling means including, fish tape, cable, rope, and basket weave wire/cable grips that will not damage cables or raceways. Do not use rope hitches as the pulling attachment to cable.

Install Exposed Cable: Install exposed cable parallel and perpendicular to surfaces of exposed structural members and follow surface contours where possible.

In Manholes: In manholes train cables around walls from entry to exit and support cables with racks or framing channel at intervals adequate to prevent sag.

Cable loops are required a minimum of each 600 ft of cable length to allow for cable movement and minimize cable stress. Loop cable around manhole interior from entrance to exit. Train cables as to not block the ladder access. Do not exceed the cable manufacturer bending radius.

INSTALLATION OF TERMINATIONS:

Install Terminations: Install terminations at ends of conductors and seal multi conductor cable ends with standard kits. Conform to manufacturer's written instructions. Comply with classes of terminations indicated. Cables not terminated within 3 hours shall be sealed to eliminate the entrance of moisture.

Tighten Electrical Connectors and Terminals: Tighten electrical connectors and terminals in accordance with manufacturer's torquing requirements. If requirements are not

indicated, tighten connectors and terminals to comply with tightening torques specified in UL 486A.

INSTALLATION OF CABLE ACCESSORIES:

Arc-Proofing: Arc-proofing shall be applied to medium voltage cables as indicated or where not protected by conduit, or termination materials. Apply arc proofing tape as recommended by the manufacturer.

Grounding: Ground shields of shielded cable at terminations, splices, and separable insulation connectors. Ground metal bodies of terminators, splices, cable and separable insulated connector fittings, and hardware in accordance with manufacturers written instructions.

Conduit Seals: Seal all conduit runs in manholes with inflatable waterproof seals.

Identification: Identify new cable #6008 and #6058 sections in accordance with Section 16195, Electrical Identification.

FIELD OUALITY CONTROL:

Subcontractor Supplied Inspection and Testing:

Test Obiectives: To ensure cable installation, including cable accessories, is operational within industry and manufacturer's tolerances, is installed in accordance with Contract Documents, and is suitable for energizing.

Procedures: Comply with InterNational Electrical Testing Association (NETA) standard, "Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems," Section 7.3.2, Cables, Medium Voltage and IEEE 400. Upon satisfactory completion of tests, attach a label identified by cable pull sheet number to the tested components.

Report Form: Test reports shall be identified by reference to individual cable pull sheet(s).

Tests: After the termination kits are installed, but prior to terminating at the equipment, the Subcontractor will perform cable testing. Coordinate the testing with the Operating Contractors Power Management group.

Testing of Temporary Installed Cables: Temporary cables shall be tested to the full test requirements except the test voltage for temporary cables shall be limited to 25 kV for new cables spliced to existing 15 kV cables. Cable pull reports are not required for temporary installed cables.

Test Report: Test reports shall be contained with and become part of the cable pull sheet. Cable pull sheets shall be in the possession of the cable tester at the test site during each test.

The Subcontractor shall maintain a written record of observations and tests, report defective materials and workmanship, and retest corrected defective items. Subcontractor shall submit written reports to the Contractor Representative.

The Contractor's Representative, shall be informed of all cable testing a minimum of two (2) working days in advance of any cable testing. The Contractor Representative shall witness or waive the right to witness field tests and inspect the installation to determine compliance with the specifications and drawings.

If any conductor in a pull group fails the test then all conductors in that pull group shall be removed and replaced at the Subcontractors expense.

Contractor Inspection: Surveillance will be performed by the Contractor's Representative to verify compliance of the work to the drawings and specifications.

END OF SECTION 16124

SECTION 16195--ELECTRICAL IDENTIFICATION

PART 1--GENERAL

SUMMARY:

Section Includes: Work includes, but is not limited to:

The Subcontractor shall provide and install labels and identification as specified herein, on the drawings, and in the appendices. See electrical drawings for equipment and wiring identifiers

Install labels on all electrical and related equipment including wires, cables, J-Boxes, receptacles, panels and disconnects.

RELATED SECTIONS:

16000 Electrical General Provisions
16110 Electrical Raceways
16120 Cable, Wires, Connectors and Miscellaneous Devices

SUBMITTALS:

No vendor data is required for this section.

PART 2--PRODUCTS

MATERIALS:

Adhesive Marking Labels for all Raceway and Metal-Clad Cable: Pre-printed flexible, self-adhesive labels with legend, identifying system type or voltage and phase.

Wire and Cable Designation Tape Markers: Self-adhering, oil and moisture resistant, vinyl labels covered with clear heat *shrink* tubing. Letters shall be typed on in black, non-smear ink. Hand lettered labels shall not be used. Engraved identification tags may also be used.

Engraved, Plastic-Laminated Labels, Tags, Signs, and Instruction Plates: Engraving stock melamine plastic laminate, 1/16 in. minimum thick for signs up to 20 sq. in., or 8 in. in length; 1/8 in. thick for larger sizes. Engraved legend and punched for mechanical fasteners.

Exterior Metal-Backed Butyrate Warning and Caution Signs: Weather-resistant, non-fading, pre-printed cellulose acetate, butyrate signs with 20 gauge, galvanized steel

backing, with colors, legend, and size appropriate to the location. Provide 1/4-in. grommets in corners for mounting.

Fasteners for Plastic-Laminated and Metal Signs: Self-tapping stainless steel screws or number 6/32 galvanized steel machine screws with nuts, flat washers, and lock washers. All signs and labels shall be glued into place using clear GE Silicone II adhesive. Duplex receptacles and light switch labels shall be glued on only. All labels larger than 1" high x 2" long shall be glued and screwed on.

Cloth, Polyethylene, Nomex, or Vinyl Tags: Installed inside 120V outlet boxes shall be white color, sized a minimum of 1" x 3", and shall have hand written or typed labeling using permanent marker.

PART 3--EXECUTION

INSTALLATION:

Install Equipment/System Circuit/Device Identification as follows: This includes low voltage power distribution, signal, and control systems. Text shall match terminology and numbering of the Contract Documents and shop drawings. Apply equipment identification labels of engraved plastic-laminate on all electrical equipment including the central or master unit of each electrical system and each sub breaker or controller. The labels shall be glued with clear silicone adhesive or screwed on with #6/32 galvanized steel machine screws with nuts.

Apply labels for each unit of the following categories of electrical work:

Pump controllers
Components, wires and cables
Disconnect switches.

Apply circuit/control/item designation labels of engraved plastic laminate.

Install labels at locations indicated and at locations for best convenience of viewing without interference with operations and maintenance of equipment.

IDENTIFICATION **AND** LABELING OF ELECTRICAL EOUIPMENT:

Background and legend colors for electrical equipment labels shall be as specified in Table I. List is not intended to be all inclusive and Subcontractor shall be responsible to insure that all new, relocated or refed equipment is labeled meeting the requirements contained within this specification.

Table I. Electrical Equipment Label Colors

Power System Classification	Power System Designator	Background Color	Legend Color
Normal	N	black	white
Standby	S	yellow	black
Emergency	E	red	white
Direct current	DC	black	white

Electrical equipment label and lettering size shall be as specified in Table 11. If equipment size constraints make the specified label size impractical, the label and lettering size will be large as possible for that particular equipment application.

Table 11. Electrical Equipment Label Sizes

Power Equipment Classification	Label Height (minimum)	Lettering Height First Line	Lettering Height Subsequent Lines
Primary Distribution Equipment	2 112 inch	3/4 inch	*318* inch
Secondary Power Distribution Switches	1 inch	*318* inch	114 inch
Disconnect Switches	1 inch	3/8 inch	1/4 inch
Power Distribution Panels	1 inch	112 inch	114 inch
Power Distribution Transformers	2 inch	112 inch	114 inch
PCC/MCC Switchgear Switchboards	2 inch	314 inch	318 inch
Power Receptacles	318 inch	3/16 inch	3/16 inch

Electrical power distribution equipment labels shall include the following as applicable:

1. The properly assigned identifier (as shown on drawings)
2. The noun name or function description
3. The voltage and the number of phases
4. The power source (fed from) equipment identifier, the circuit number (if applicable), and building in which power source is located if different from equipment location

5. In addition to the above 4 items, transformers, UPS, substation switchgear, load center switchgear, service entrance equipment cubicles, and disconnect switch labels shall contain the destination (fed to) power equipment identifier fed by the transformer secondary or disconnect switch.

Example Panel Labels:

SLP-MA-447
LIGHTING PANEL, 408/277V, 3 PHASE
FED FROM: PANEL PCC-MA-448A CKT 9

PCC-cw-419
POWER PANEL, 208/120V, 3 PHASE
FED FROM: TRANSFORMER XFR-CW-187

Example Disconnect Label:

DSW-UTI-4500
DISCONNECT SWITCH
FED FROM: LP-MA-447 CKT 9
FEEDS: BLO-UTI-4500

Labels are to be made from materials that are compatible with the application. Brass or stainless steel shall be used where shown on the drawings.

The equipment label(s) shall be located on the front of electrical equipment in as visible a location as possible.

Separate labels shall be utilized for the identification of cautions or dangers required by code and as designated on the drawings.

IDENTIFICATION AND LABELING OF CIRCUITS, CABLES, AND WIRE:

Each individual circuit breaker in a panelboard shall be clearly identified by a circuit number appropriate to the individual panelboard. All circuits, breakers, or spaces that are spare, blank, or utilized for power distribution shall be properly identified on the panel legend provided by the Subcontractor or manufacturer. The method of identification shall be as follows:

Panelboard Breakers: Single and multiple pole breakers shall be numbered as shown on the drawings and schedules. A type written circuit directory shall be installed in each panel and a copy furnished to the Contractor.

Conductors: All conductor identification shall include the panel identifier and the circuit identification number from the panel and the voltage.

Example Conductor Label: A conductor from SLP-MA-447, circuit No. 4, @ 120V would be identified with the identification number SLP-MA-447 ckt 4, 120V.

Conductors to 120V duplex receptacles do not need to be labeled if continuous wire color code is utilized. All 277/480V circuit shall be labeled.

Each conductor or cable shall also be clearly identified and labeled in all electrical pull boxes or junction boxes. Engraved, laminated plastic identification tags are acceptable for this purpose when attached to each conductor or to the box collar.

Control Wiring: All control wires shall be labeled with "from" and "to" identification at each termination point. The "from" location will be first and be separated from the "to" location by the use of a slash (i.e. TB1-2/TB6-5).

Below Grade Power Circuit Identification: Securely fasten identifying tags to cables, feeders, and power circuits in manholes, pull boxes, and junction boxes. Tags shall have engraved legend to correspond with designations in specifications and on drawings. Attach tags with approximately 55-lb. test monofilament line or one-piece self-locking nylon cable ties. Tag cables at each entry and exit of the manhole or once in a pull box or J-Box.

Conductor Color Coding: Provide color coding for secondary service, feeder, and branch circuit conductors throughout the project secondary electrical system as specified in Section 16120.

Sequence of Work: Where identification is to be applied to surfaces that require finish, install identification after completion of finish work.

CONDUIT LABELS:

Conduits shall be identified by a label attached parallel or encircling the conduit with a legend of the conductor characteristics including: highest voltage level contained within the conduit, AC or DC current, number of phases, and service type (FA for Fire Alarm, ENS for Emergency Notification, VP for Voice Paging, EVAC for Evacuation), if applicable.

Example Conduit Label: 120V, AC, 1 Ph, FA.

Conduit labels shall be color-coded as specified in Table 111:

Table III: Conduit Label Colors

Power Type	Background Color	Lettering Color
Normal Power	Orange	Black
Standby Power	Yellow	Black
Emergency Power	White	Red

Labeling Size and Placement: The minimum letter height of content and identification labels of raceways and conduit shall be as specified in Table IV below. **A** letter size of at least one half the trade diameter is recommended for conduit. The label shall be as long as required to display the specified information.

Table IV. Conduit Label Sizes

Raceway or Conduit Size (inches)	Minimum Height of Lettering (inches)
3/4 to 1¼	½
1 1/2 to 2	¾
2 1/2 to 6	1 %
8 to 10	2 %
Over 10	3 %

Note: The size refers to the nominal diameter for conduit or the width of the raceway or cable tray.

Exposed raceways and conduits shall be labeled within 3 ft of the power source and adjacent to process equipment; adjacent to each side of any penetration through floors, walls, or bulkheads. Labels shall be placed at intervals not to exceed 20 ft on straight runs of conduit. Raceways and conduit shall be labeled at least once in each room through which they pass. Labels shall be located to facilitate ease of identification. Conduction ceiling space above suspended ceilings shall be labeled.

WARNING, CAUTION, **AND** INSTRUCTION SIGNS:

Identify Junction and Connection Boxes: Code-required caution sign for boxes shall be pressure-sensitive, self-adhesive label indicating system voltage in black, pre-printed on orange background. Install on outside of box cover. Use pressure-sensitive plastic labels at exposed locations and similar labels or tags at concealed boxes.

Apply warning, caution, and instruction signs and stencils as follows:

Install warning, caution, and instruction signs where required by NEC, where indicated on the drawings, and where required to assure safe operations and maintenance of electrical systems and of the items to which they connect. Install engraved plastic-laminated instruction signs with instructions or explanations needed for system or equipment operation. Install butyrate signs with metal backing for outdoor items.

FIELD OUALITY CONTROL:

Contractor Inspection: Surveillance will be performed by the Contractor's Representative to verify compliance of the work to the drawings and specifications.

END OF SECTION 16195

SECTION 16360--DISCONNECT SWITCHES 600 V AND LESS

PART 1--GENERAL

SUMMARY:

Section Includes, but is not limited to:

The Subcontractor shall provide and install electrical disconnect switches of types, grades, and sizes as shown on the drawings. Provide complete assembly including, but not necessarily limited to hubs and other components and accessories as needed for a complete system.

Related Sections:

16110 Electrical Raceways
16195 Electrical Identification

REFERENCES:

The following documents including others referenced therein, form part of this Section to the extent designated herein:

NATIONAL FIRE PROTECTION ASSOCIATION

NFPA 70	National Electrical Code (NEC)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION

NEMA ICS 2, Part 8	Disconnect Devices for Use in Industrial Control Equipment
NEMA 250	Enclosures for Electrical Equipment

SUBMITTALS:

No vendor data is required for this section.

PART 2--PRODUCTS

MANUFACTURERS:

Acceptable Manufacturers Other Than Specified: Square D or Cutler-Hammer.

MATERIALS:

Disconnects: Disconnect switches shall be UL listed, NEMA Type 3R, heavy duty single throw, non-fused, and have current and voltage rating as shown on the drawings.

Switches shall be operated with external operating handle which is an integral part of the box--not the cover. The operating mechanism shall be quick-make, quick-break and shall not be capable of being restrained by the operating handle during the opening and closing operation.

Dual interlocks shall interlock the switch box cover with the switch mechanism and shall prevent opening or closing the box cover when the switch contacts are closed and the switch mechanism is in the "ON" position. **An** interlock release shall be provided to defeat the interlocking mechanism and to permit opening the box cover when the switch contacts are closed. To defeat the interlock release and permit opening the box cover shall require an external hand tool.

Switch handles shall be designed for padlocking in the "OFF" position, locking the door closed to inhibit access to the switch. All current-carrying metal parts of the switch shall be enclosed.

PART 3--EXECUTION

INSTALLATION:

Install disconnect switches as indicated on the drawings and in accordance with manufacturer's written instructions, applicable requirements of NEC and National Electrical Contractors Association's "Standard of Installation," and comply with recognized industry practices to ensure that products serve intended functions.

Install disconnecting devices associated with motors within sight of the motor driven device where practical. In all cases the disconnecting device shall be clearly labeled to distinguish which motor/piece of equipment it disconnects.

LABELING:

For labeling requirements see Section 16195--ElectricalIdentification.

FIELD OUALITY CONTROL:

Site Tests: Visual inspection to determine that equipment installation conforms to NEC, these specifications and the drawings.

Contractor Inspection: Surveillance will be performed by the Contractor's Representative to verify compliance of the work to the drawings and specifications.

END OF SECTION 16360

SECTION 16450--GROUNDING

PART 1--GENERAL

SUMMARY:

Section Includes: Work includes, but is not limited to:

Subcontractor shall provide and install grounding of sizes, ratings, materials and types as shown on the drawings and as recommended by the NEC and the NESC.

RELATED SECTIONS:

16000 Electrical General Provisions
16110 Electrical Raceways

SUBMITTALS:

No vendor data required for this section.

PART 2--PRODUCTS

MATERIALS:

Equipment grounding conductors shall be green insulated (#6 AWG and Smaller) or bare copper, sized and located as shown on the drawings.

Grounding rods shall be a minimum of 5/8-in. diameter and 10 ft long copper clad steel.

Grounding connections below grade shall be made by the exothermic welding process or UL listed nonreversible compression fittings.

Exothermic welds shall be Cadweld.

Nonreversible compression fittings shall be Burndy-HyGround.

PART 3--EXECUTION

INSTALLATION:

Install a complete grounding system as indicated on the drawings in accordance with applicable requirements of the NEC, the NESC, and complying with recognized industry practices to ensure that products serve intended functions and comply with requirements.

All exposed noncurrent-carryingmetallic parts of the electrical equipment and raceway systems shall be grounded

All new conduit (except spares) shall contain a dedicated grounding conductor. Connect the conduit grounding bushing with a base ground conductor to the ground bus/conductor in the equipment where the conduit terminates.

Conduit shall not be used as the grounding conductor.

Grounding Rods: Grounding rods shall be driven as shown on the drawings. The grounding rods shall be driven so that the top of the rod is 1 ft below finished grade.

Exothermic Welds: Exothermic welds shall be made in accordance with the manufacturer's written recommendations.

Non-reversible Compression Connections: Connections shall be made in accordance with manufacturers written recommendation.

FIELD QUALITY CONTROL:

Site Tests: The Subcontractor or his agents shall perform visual inspections to determine that the grounding installation conforms to the NEC, these specifications, and the drawings.

Contractor Inspection: Surveillance will be performed by the Contractor's Representative to verify compliance of the work to the drawings and specifications.

END OF SECTION 16450

SUBCONTRACT NO. XXXXX

SCHEDULE "X"

The Government will furnish to the Subcontractor at no cost the equipment or material listed below. The equipment or material may be obtained by the Subcontractor at the time he is ready to make the Installation in accordance with the provisions of the contract.

The items will be available only during normal working hours and a twenty-four (24) hour minimum advance notice (Saturdays, Sundays, and holidays excluded) to the Construction Coordinator (STR) will be required.

Transportation costs shall be the responsibility of the Subcontractor.

Item No.	Description	Quantity	Turnover Location	Reference	Approximate cost	Date Available
1	Pre-cast concrete manhole (MAH-YDF-BW-491)	1	Location of installation	Dwg. C-7	N/A	TBD
2	Approx. 25-ft section of 48" cmp culvert with connection bands	1	Location of installation	Dwg. C-7	NIA	TBD

Project Title: **OU 3-13, Group 1, Tank Farm Interim Action Phase 1**
Document Type: **Construction Specifications** **Project Number:** **020978**
SPC Number: **458**

GEOMEMBRANE INSTALLERS CERTIFICATION
OF SUBSURFACE ACCEPTABILITY

The geomembrane installer, _____
for the OU **3-13,** Group 1, Tank Farm Interim Action Phase 1 Evaporation Pond, hereby certify that the supporting prepared subgrade surfaces are acceptable for installation of the HDPE geomembrane lining system, the undersigned having personally inspected the condition of the constructed surfaces. This certification is for the areas shown on Attachment or defined as follows:

_____

_____

_____

_____

_____

The condition of the supporting surfaces in the defined area meets or exceeds the minimum requirements for installation of the geomembrane.

Signed: _____
Geomembrane Installer

_____
Date Signed

Signed: _____
Construction Subcontractor

_____
Date Signed